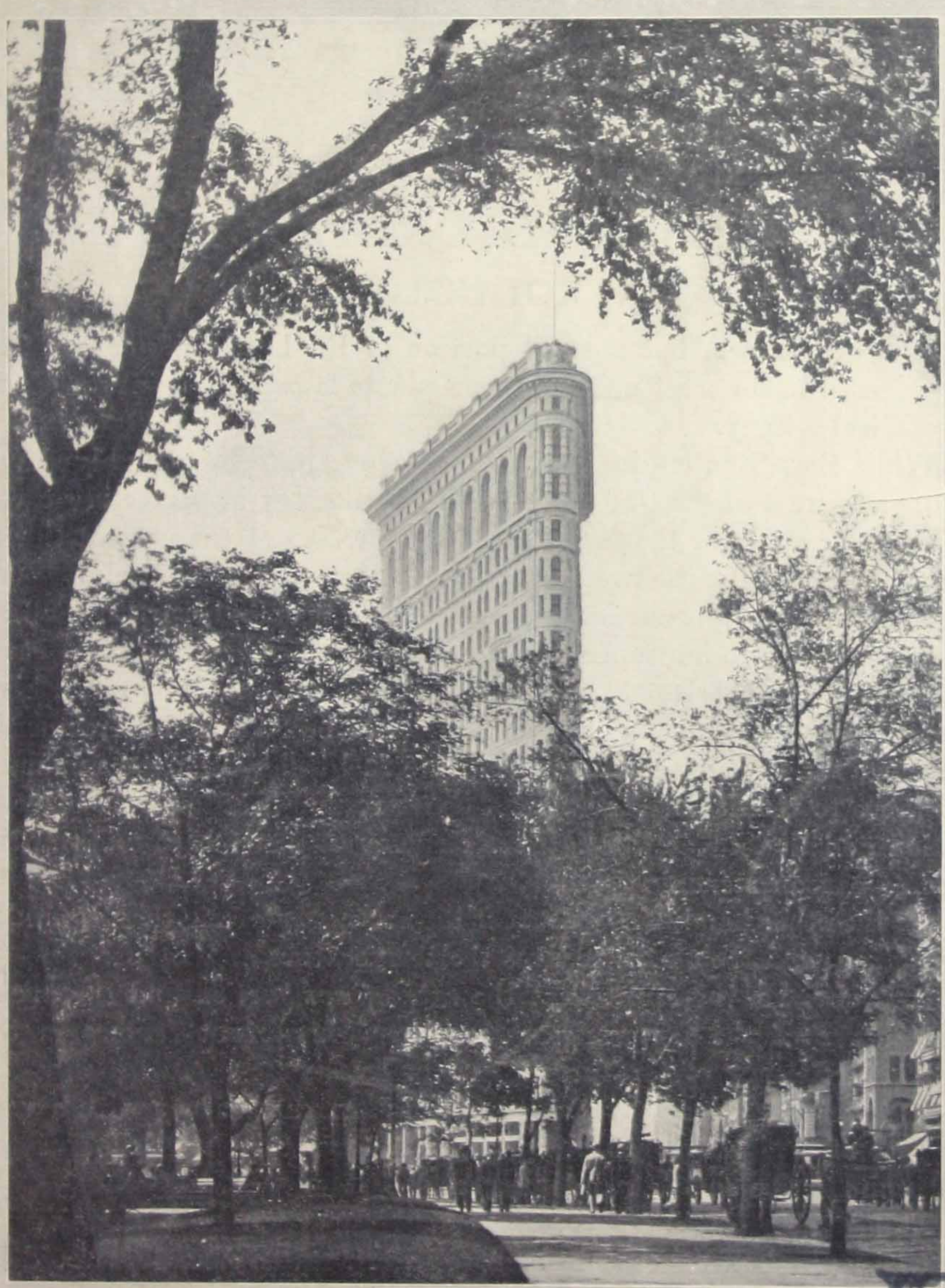
BALANCED DRAFT installed under license from The Engineer Company is in operation under boilers aggregating upwards of one-half million horse-power.

(Trade Mark "Balanced" Reg. U. S. Pat. Off.)

The Engineer Company,

Sole Owners of the Basic Patents controlling The Balanced Draft System.

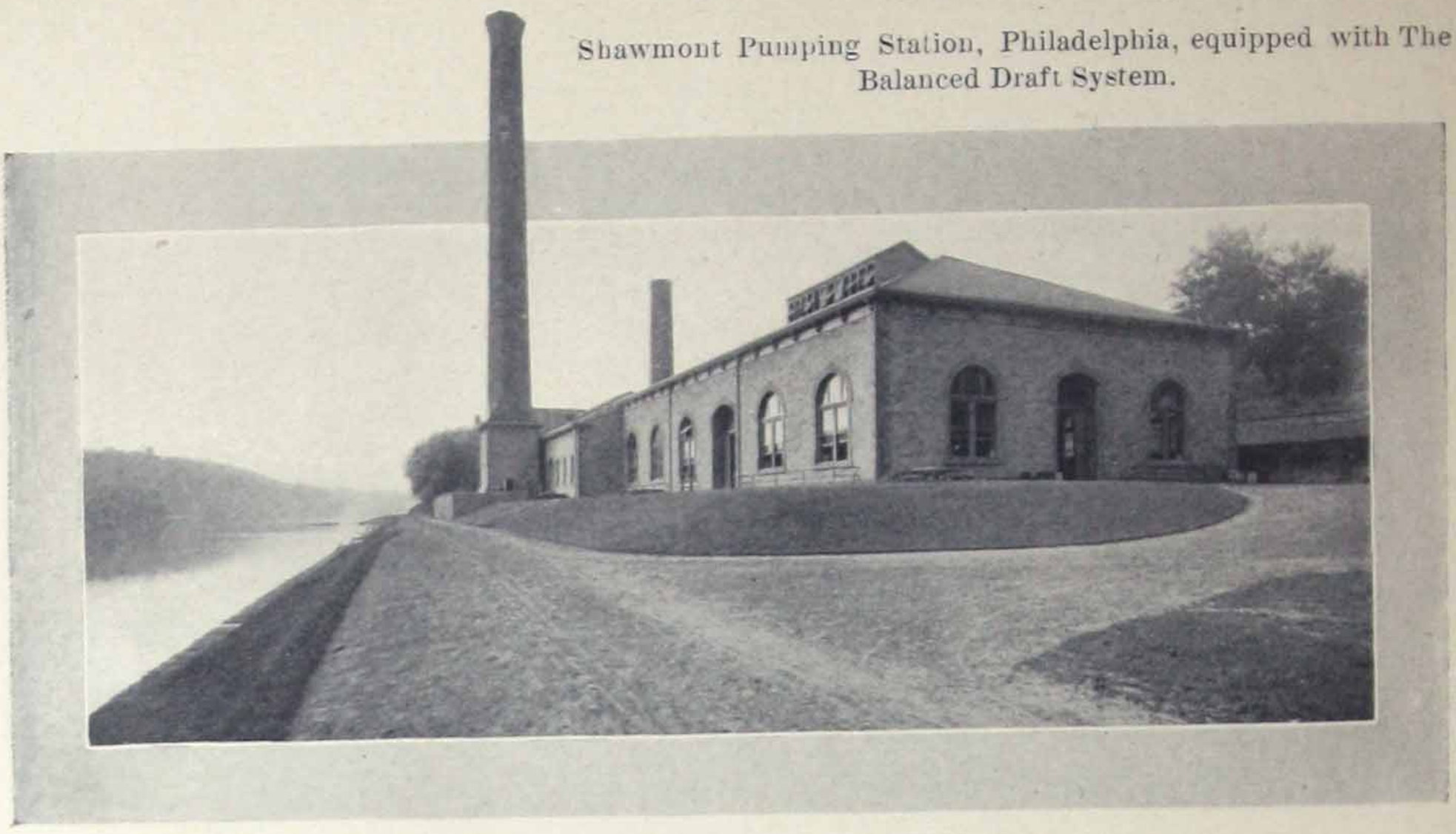
New York Trinity Building, 111 Broadway



Fuller (Flatiron) Building, New York, from Madison Square. Boiler plant equipped with Balanced Draft.

Draft Regulators

FI



Shawmont Pumping Station, Philadelphia, equipped with The Balanced Draft System.

THE BALANCED DRAFT SYSTEM

INTRODUCTORY

AS is well known, but a small portion of the heat units of the fuel used in the most modern steam plants is converted into mechanical energy.

While the steam engine and steam turbine have been highly developed, and a vast amount of attention has been spent in perfecting them, the scientific study of the *furnace* and *boiler* offers at the present time a more fertile field for the progressive engineer.

A considerable proportion of the loss of heat units occurs in the furnace, and is due to improper conditions for combustion. In some cases the draft is not sufficient to supply the requisite quantity of air, a high grade of fuel is required, and the fire has to be "cleaned" frequently to remove the ash and clinker, so that the fuel bed will offer a minimum resistance to the draft. Insufficient draft results in a low rate of combustion and the escape through the chimney of many heat units in the form of carbon monoxide gas.

On the other hand, if the draft is too strong, more air than is needed is supplied, and the excess reduces the temperature of the furnace.

It is obvious, therefore, that the *rate of combustion* and the *initial temperature* of the furnace gases are very important factors in the *combined* efficiency of the furnace and boiler.

It is possible to maintain a very high *furnace* efficiency with a very low rate of combustion and low furnace temperature, nearly all of the heat units in the coal being developed.

Under these conditions, however, the proportion of heat units absorbed by the boiler would be small and the boiler efficiency would be

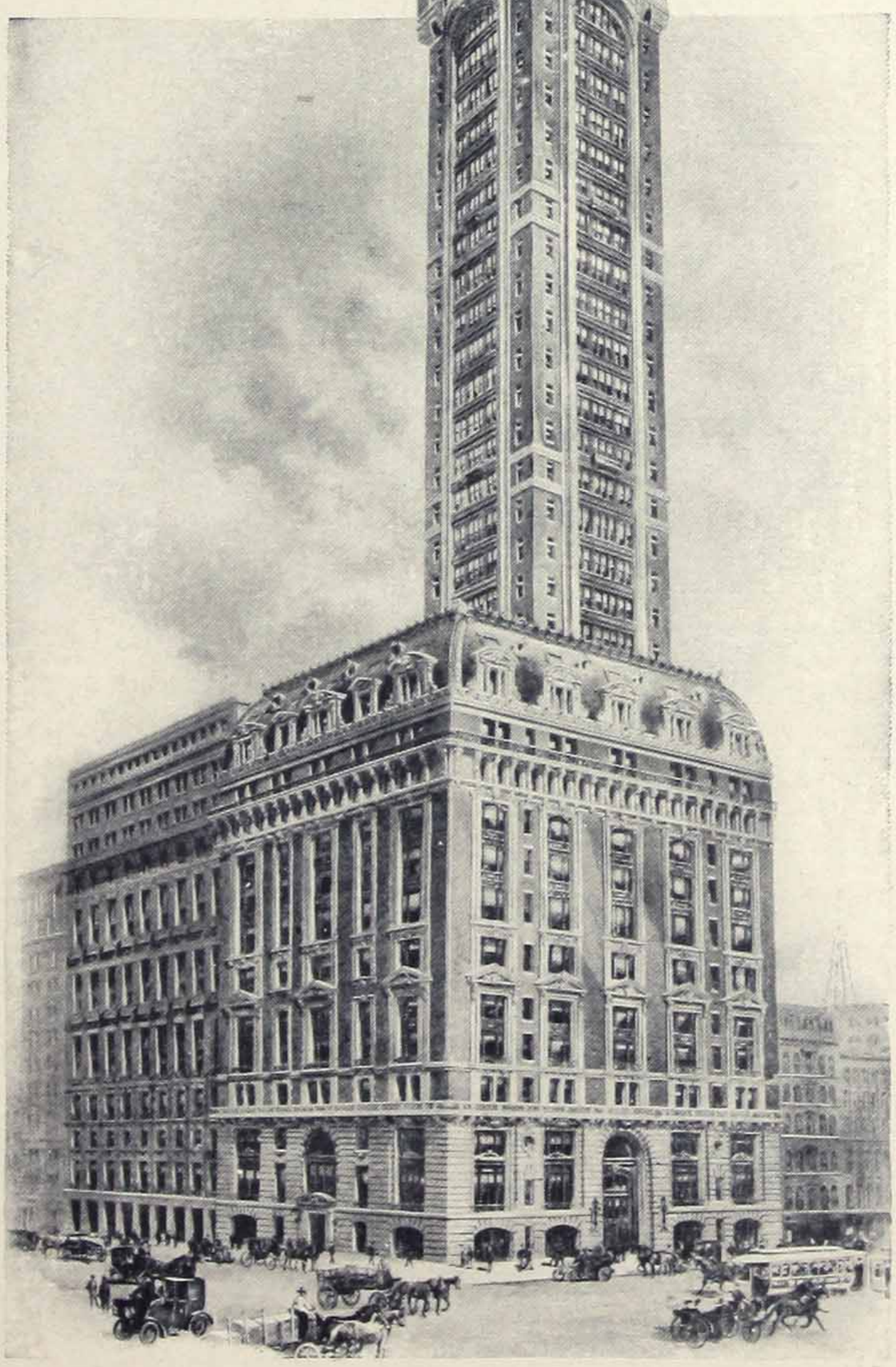
very low. A large proportion of the heat units generated in the furnace would pass up the chimney.

It is evident, therefore, that the furnace and boiler must be considered together:

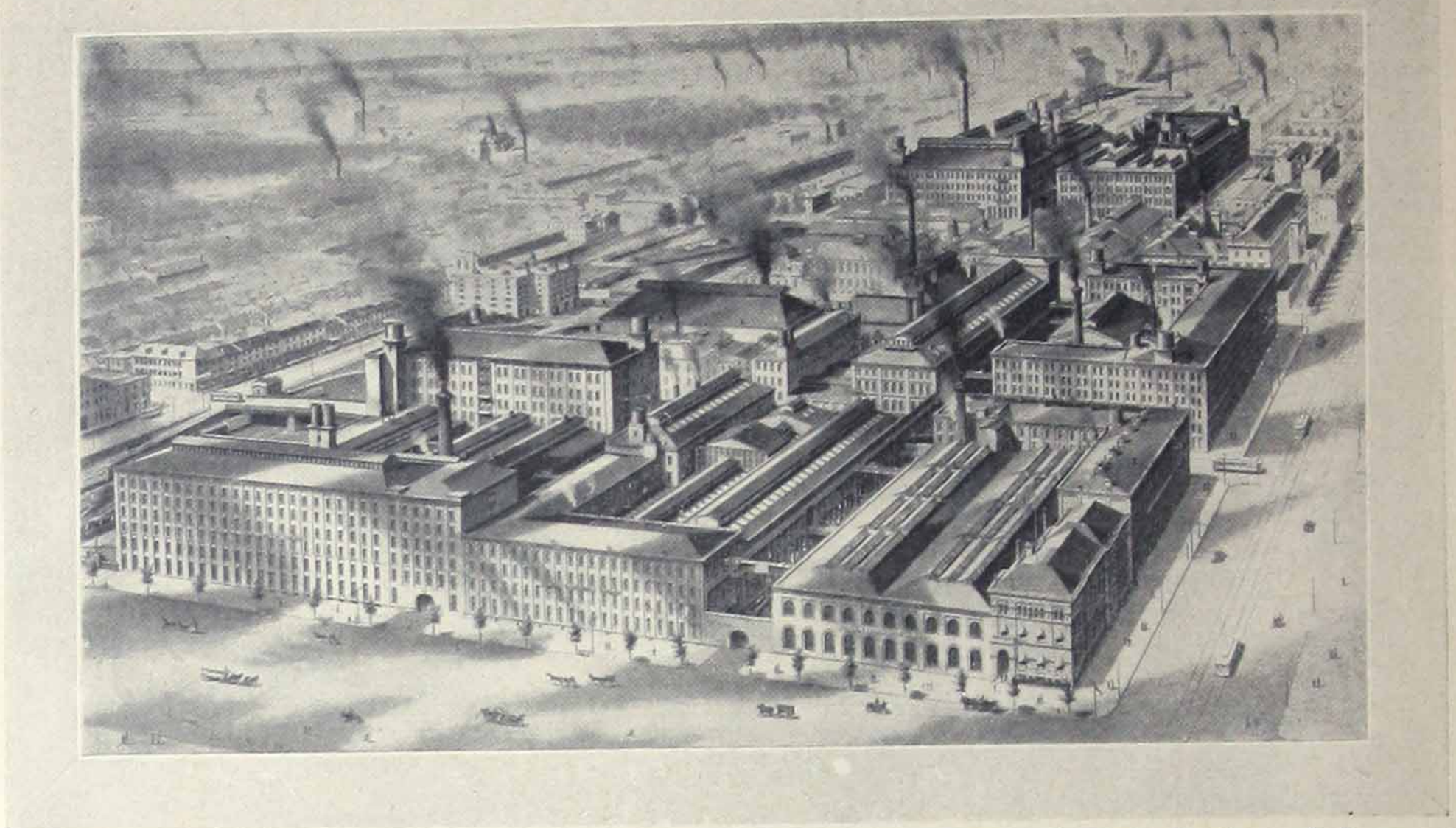
The ideal conditions for attaining this combined result to a maximum degree are furnished by The BALANCED DRAFT System.

This System has been designed after seventeen years of experiment and research under actual working conditions. It has overcome in a great measure these defects in what have been considered our most modern and efficient boiler plants.

"BALANCED DRAFT" is fully protected by patents granted in the United States, Canada, Mexico, Great Britain, France, Germany, Italy, Spain, Denmark, Switzerland, Norway, Transvaal, Belgium and Australia, and patents are pending in other countries. The brief *résumé* given on the following pages, together with the general description of the System, the table of actual working tests, and the commendation received from those who have adopted and used it after having such tests made, should justify a thorough examination of the merits of the "Balanced Draft" System by those interested in boiler plants of any description where economical operation, capacity of output, and close regulation are important conditions.



The Singer Building, New York. The highest building in the World. Boiler plant is equipped with The Balanced Draft System.



Baldwin Locomotive Works, Philadelphia. Equipped with The Balanced Draft System of Furnace Regulation.

THE "BALANCED DRAFT" SYSTEM OF FURNACE REGULATION

The term "Balanced Draft" is applied to that method of operating boiler furnaces by which the supply of air and exhaust of gases are so regulated that a substantially uniform or atmospheric pressure is maintained in the fire chamber for varying rates of combustion. By its use the air supplied to the furnace can be limited to *just* the proper amount that is required for the maintenance of the desired rate of combustion, all excess of air being detrimental. In other words, "Balanced Draft" is the system which accomplishes the scientifically correct and commercially perfect combustion of fuel under boilers. The System, "Balanced Draft," not alone increases the capacity and efficiency of furnaces and boilers, but permits the use of cheaper fuels, the combined results effecting the large commercial savings shown.

Another and important consideration in favor of "Balanced Draft" is increased life of the boiler and setting, and reduction in maintenance and repair expenditures, due to the elimination of strains caused by unequal expansion and contraction and the consequent disintegration of furnace linings.

The resulting economies from the application of The Balanced Draft System are naturally great, averaging about 25 per cent. in the installations made to date, with about the same average increase in

capacity. The capacity increase has amounted, in exceptional instances, to over 100 per cent., all results having been attested by well-known, responsible engineers under the prescribed A. S. M. E. code of rules.

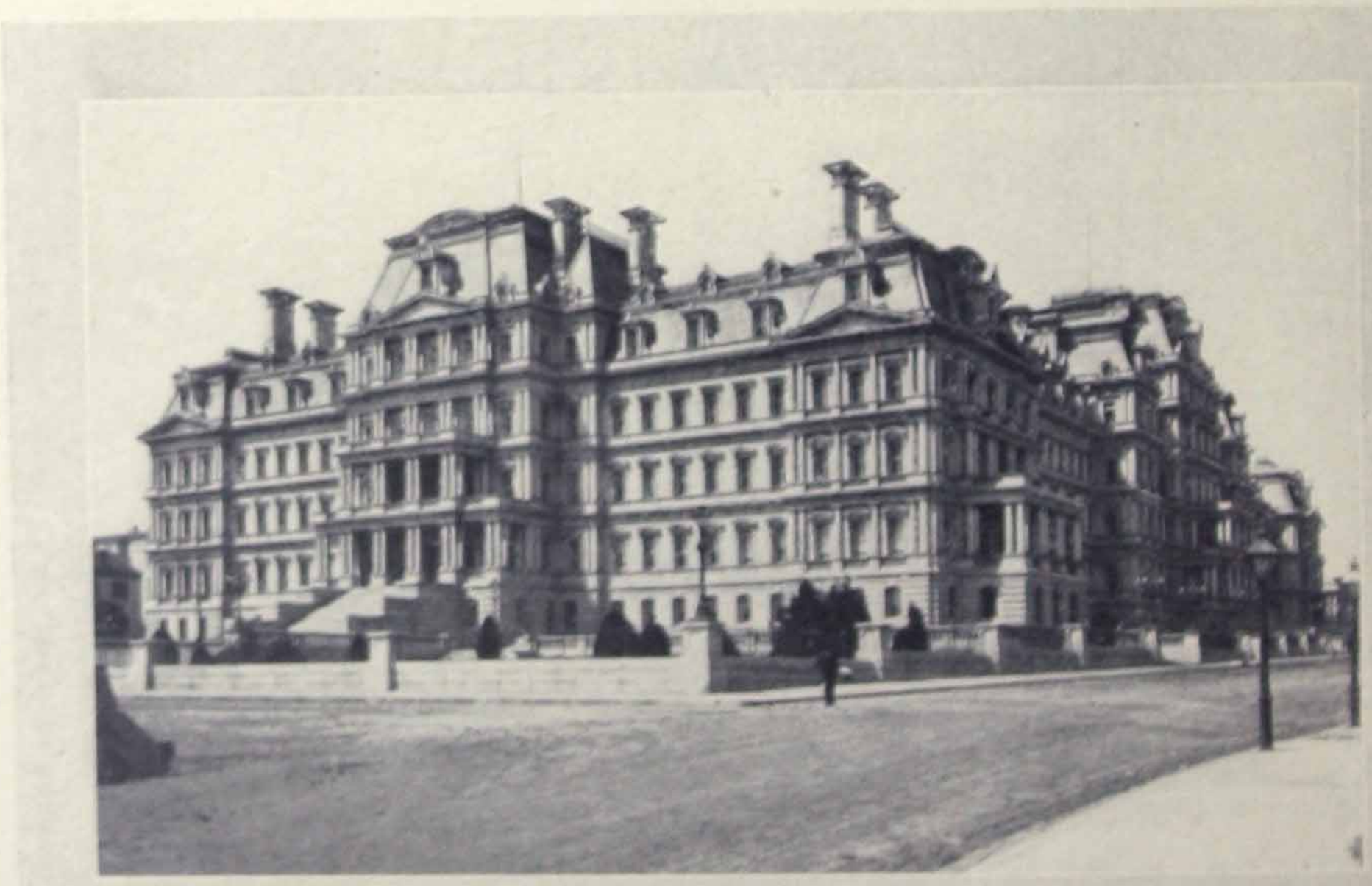
While to-day anything pertaining to economy in the production of

Trinity and U. S. Realty Buildings, New York, Home of The Engineer Company. Boiler plant will be equipped with The Balanced Draft System.

steam power is likely to be given serious consideration, likewise is the present-day engineer apt to receive with suspicion such apparently extravagant suggestions as just made. Highly unbalanced drafts to quicken the fire have been so universally employed that prejudice is incited against the man who contends that their use is inherently wrong. Yet it is a fact that draft as ordinarily applied, either natural or mechanical, is all wrong, and that the investment for either the conventional chimney or blowing outfit represents not only a waste in first cost, but entails a continuous lack of economy.

When the principles of "Balanced Draft" were explained to the superintendent of an office building in New York City by the inventor of the "Balanced Draft" System some months ago, the point was made that with Balanced Draft a handkerchief could be suspended at the furnace door, even when the boiler is being worked far in excess of its rated capacity, without there being any deflection of the handkerchief in either direction, proving the lack of draft as generally understood. The gentleman misunderstanding the purport of the remarks responded:

"Mr. McLean, our power plant is located in the sub-basement of a twenty-five-story building, and the top of our stack is 350 feet above the ground. Do you know that if you were to hold a handkerchief at our furnace doors when they were open, it would be whiffed out of your hand and up the stack without ever touching the bed of the fire,



State, War and Navy Departments Building, Washington, D. C. Boiler plant was equipped with The Balanced Draft System of Furnace Regulation after a trial with a down-draft installation.

and for that reason we never have any trouble in keeping up steam, and we only average ten tons of pea-coal a day."

The erroneous idea of this gentleman so impressed Mr. McLean, together with the fact that upon him alone devolved the economy of a 500-horse-power modern office-building steam plant, that the principles involved were explained to him in a most painstaking manner. The Engineer Company's methods of meeting them was likewise elucidated, with the result that a contract was signed in which The Engineer Company guaranteed the owners of the building in question (while furnishing the same power as formerly) to reduce the average coal consumption to nine tons per day, using a grade of coal which costs One Dollar and Twenty-five Cents *less* per ton than the pea-coal, thus effecting an annual guaranteed saving of Four Thousand Five Hundred and Seventy-five Dollars ($4,575).

Manhattan Life Building, New York. Boiler plant is equipped with The Balanced Draft System.

"Balanced Draft" automatically maintains in the furnace a pressure equal to the surrounding atmosphere, and limits the air introduced to the quantity required to effect perfect combustion through the entire range of demands upon the boiler.

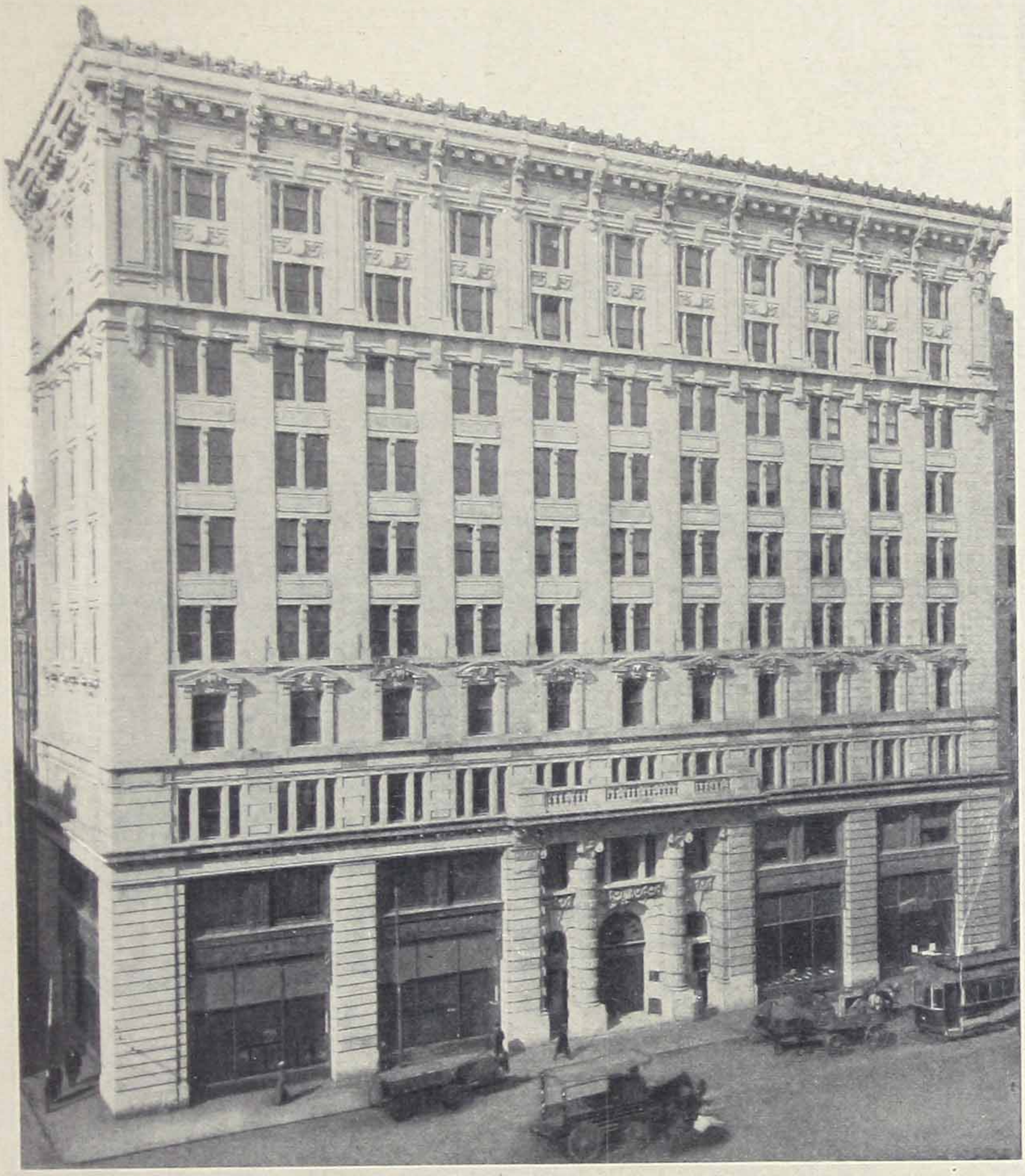
The draft is balanced by throttling the suction of the chimney in exact proportion to the speed of a specially designed fan-blower which supplies air to the ashpit, and the speed of which in turn is governed by variations in the boiler pressure. The position of the damper varies

in unison with the variations in speed of the blower, being controlled either by the steam pressure actuating the blower engine, or by the pressure of the gases in the furnace chamber. The fan-blower is so designed that it will deliver approximately a constant volume of air of variable pressure for any given speed. The volume varies with the speed, and the pressure varies with the resistance. The pressure in the ashpit, therefore, varies with the thickness of the fuel bed, and the volume of air varies in accordance with the demands for steam made upon the boiler, and is limited to the minimum amount of air required to maintain the necessary rate of combustion. The attained result is that twelve pounds of air combining with one pound of coal produce maximum efficiency, maximum economy, and reduce to a minimum the liability of injury to the furnace and boilers, present in forced or natural draft conditions, due to the inrush of cold air when the furnace doors are opened.

American Surety Building, New York. Power and lighting plant equipped with The Balanced Draft System of Furnace Regulation.

As just the exact quantity of air necessary to maintain the rate of combustion to keep up the boiler pressure is supplied, and there is no suction from the chimney to draw an excess (usually as much as 100 per cent.) of air through the fire, or through the fire door when open, or through cracks in the boiler setting, or through porous brickwork, the temperature of combustion is not reduced by such excess of air; nor are the gases diluted and their temperature lowered, with the consequent loss of efficiency and the carrying of an excess of heat up the chimney.

It follows that as any desired ashpit pressure and rate of air supply can be maintained with a minimum loss of heat up the chimney, not only can greatly increased economy be obtained when using the better



John Hancock Building, Boston. Boiler plant is equipped with The Balanced Draft System of Furnace Regulation.

grades of fuel, but the cheapest grade of fuel can be burned economically, and at the same time the normal boiler capacity maintained. Analysis of the chimney gases, where Balanced Draft is used, demonstrates conclusively that this result is effected, and it is not uncommon for the "Balanced Draft" System to obtain an average result of from 15 to 18 per cent. of CO_2 with scarcely a trace of CO, and 3 to 5 per cent. of O.

As the rate of absorption of heat by a boiler varies with the difference of temperature between the gases and the boiler, it is evident that

the increased initial temperature of the gases in the "Balanced Draft" furnace will result in a much higher rate of evaporation for the boiler. Furthermore, as the air is restricted to one-half the amount ordinarily supplied to the furnace, the volume of the gases generated is reduced to substantially one-half the volume usually produced by the combustion of a given amount of coal. Consequently, the velocity of travel of the gases through the boiler can be reduced one-half, and still pass the same number of effective heat units through the boiler in a given time.

As time is an element in the absorption of heat by the boiler, it is evident that with "Balanced Draft" the boiler will absorb a much larger proportion of heat from the gases. If the temperature of the waste gases remains the same in a boiler after it is equipped with "Balanced Draft," it is evident that the number of heat units passing up the chimney has been reduced one-half, due to the decreased volume of gas. If the temperature of the terminal gases where "Balanced Draft" is used is lower than under ordinary conditions, it is evident that more than one-half of the heat units, which were formerly wasted by passing up the chimney, have been absorbed by the boiler in useful work.

When it is borne in mind that in a boiler of the Babcock & Wilcox type, about 80 per cent. of the total evaporation is effected in the tube surfaces between the front headers and the first set of baffle plates at the bridge wall, it is evident that a boiler of this type can be operated with the "Balanced Draft" System without any baffle plates, without reducing the efficiency and with a large increase in the evaporating capacity. In other words, a boiler so equipped would evaporate between six and seven pounds of water per square foot of heating surface, at substantially the same efficiency that it now evaporates 3.4 pounds of water when operated at its present rated capacity.

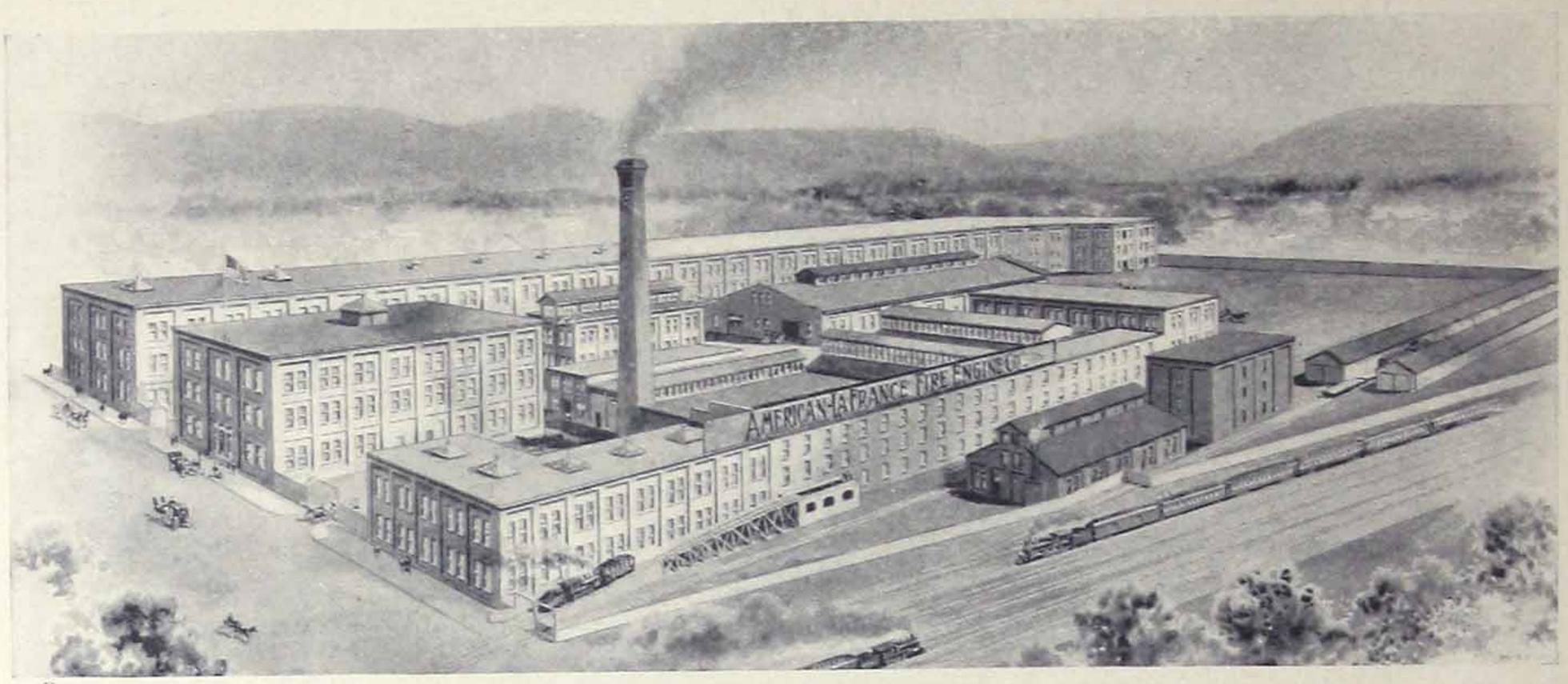
Another feature worthy of consideration, especially in municipalities where there are laws against the smoke nuisance, is that highly volatile coal can be burned smokelessly, even when the boiler is operating considerably above its rated capacity by use of a special setting in combination with "Balanced Draft."

Obviously there is nothing to prevent the operation of a furnace equipped with any of the various mechanical stokers with "Balanced Draft." While the original researches, inventions and patents were in connection with hand-fired furnaces, most satisfactory results have been obtained with STOKERS and "BALANCED DRAFT."

The method described, as well as the special equipments employed to effect these results, are broadly covered by United States and for-

Broad Exchange Building, New York. Power and Lighting plant equipped with The Balanced Draft System of Furnace Regulation, displacing Down Draft.

eign patents, granted to Embury McLean, President of The Engineer Company, who own and control these patents.



Works of American La France Fire Engine Company, Elmira, N. Y., whose power plant is equipped with The Balanced Draft System of Furnace Regulation.

"BALANCED DRAFT" increases both the CAPACITY and EFFICIENCY of the boiler and furnace:

1st. **By Attaining the Highest Possible Temperature of the Gases of Combustion.** When the supply of air has reached the proper amount for perfect combustion, viz., approximately 12 pounds of air to each pound of coal, the furnace is developing its maximum temperature. Any excess of air beyond this amount will reduce the temperature of the furnace by diluting the gases with the air that does not combine with the coal. As the boiler absorbs heat in proportion to the difference of temperature between the gases and the boiler, maximum temperature of furnace gases gives the maximum rate of absorption of heat by the boiler.

2d. **By Increasing the Time of Contact of the Gases with the Heating Surface.** As the volume of gases generated is reduced to a minimum for a given quantity of coal burned, the velocity of their travel through the boiler can be proportionately reduced. As time is an element in the absorption of heat by the boiler, the greater time the gases are in contact with it, due to the reduced velocity, the greater the proportion of heat in the gases absorbed by the boiler.

3d. **By Increasing the Effective Heating Surface.** The reduced velocity of the gases and their distribution and diffusion to all parts of the heating surface makes every inch effective instead of having a considerable portion of the heating surface pocketed or out of the direct line of travel of the gases from the edge of one baffle plate to the next.

The Capacity is Further Increased by the Possibility of Effectively Burning a Greater Amount of Coal.

As the volume of gases from a given quantity of coal burned is reduced by the exclusion of excess air, the quantity of coal effectively burned in a given time can be proportionately increased.

It is a fact beyond question that The Balanced Draft System will double the horse power capacity of the stack. Balanced Draft reduces the function of the stack to merely that of removing the gaseous products of combustion from the furnace.

Fuller (Flatiron) Building, New York, where The Balanced Draft System replaced a down-draft furnace.

Extract from the Question Box of the Thirtieth Convention of the National Electric Light Association, Washington, D. C., June 4-7, 1907.

QUESTION F—1 *What experience have members had with the McLean Balanced Draft System of The Engineer Company, New York?*

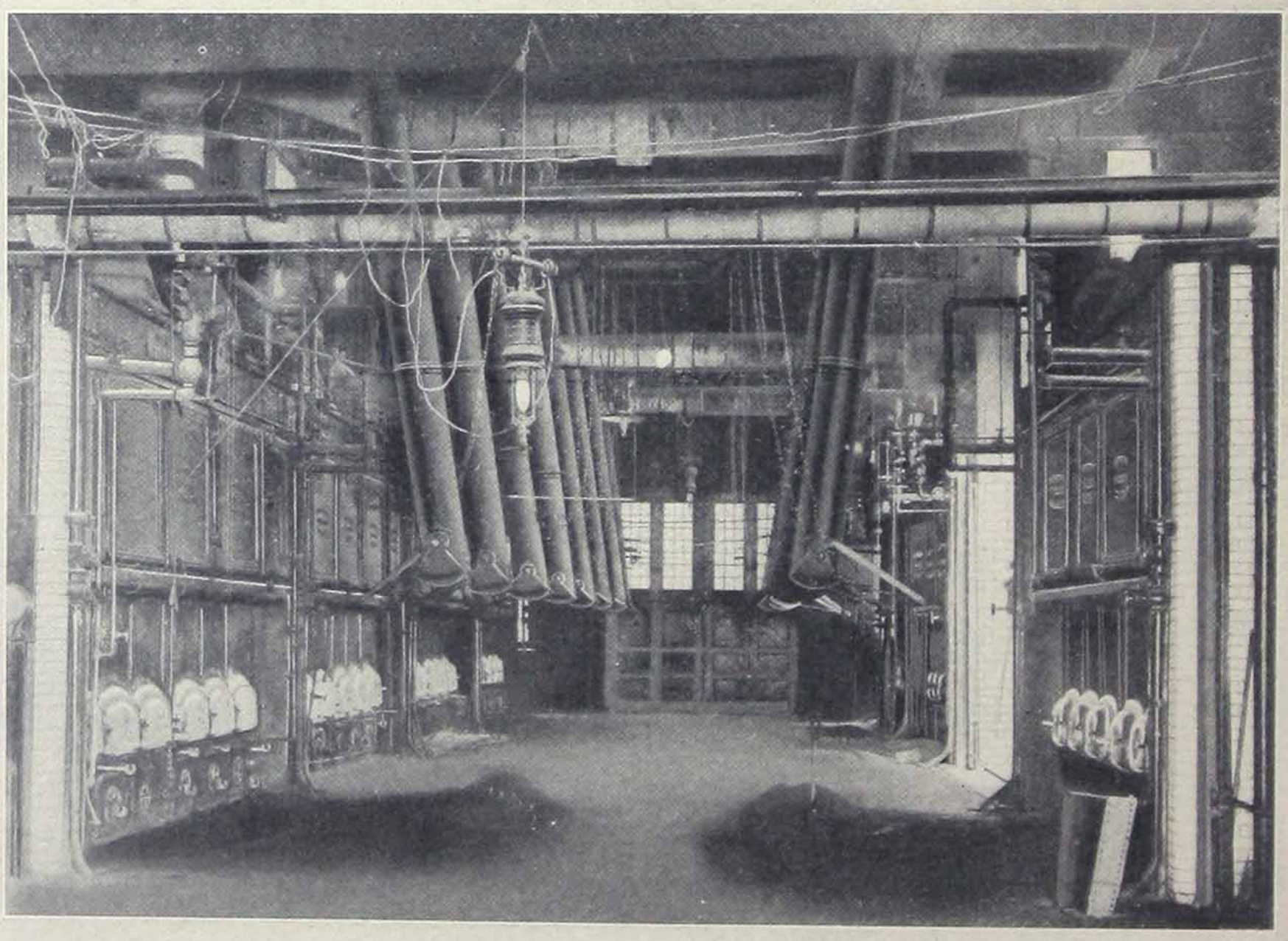
Experience of the Hudson River Electric Power Co. with the McLean Balanced Draft System of The Engineer Co. of New York, installed in their Turbine Station at Utica, N. Y.

ALBANY, N. Y., May 7, 1907.

This plant was built to be used as an auxiliary to a water power development, and was equipped with an Induced Draft System in order to get steam as quickly as possible when it becomes necessary to operate the plant.

A proposition was received from The Engineer Co. to effect a saving of twenty per cent. in the cost of fuel by using their Balanced Draft System instead of the Induced Draft System. They also guaranteed an increased capacity for the boilers.

A series of nine tests was made with the Induced Draft using various kinds and mixtures of coal; and a second series of thirteen tests was made with the Balanced Draft using various kinds and mixtures of coal.



Boiler Room of Utica Turbine Power Station, Hudson River Electric Power Co., equipped with The Balanced Draft System.

As a result of these tests it was found that The Balanced Draft System effected a saving in the cost of coal of over twenty per cent., and that the capacity of the boilers was materially increased.

The analysis of flue gases showed an average with the Induced Draft System of 5.9% of CO_2 and an average with The Balanced Draft System of 16% of CO_2.

The most economical mixture of coal has been 84% of anthracite, No. 2 and No. 3 buckwheat; and 16% of bituminous slack. With the Induced Draft System the smoke was so dense that the city authorities insisted upon the company using apparatus which would not cause a violation of the smoke ordinance. Since the installation of The Balanced Draft System there has been no complaint from the city, as there is practically no smoke.

In the following statement of cost of operation the steam required to operate the engines for both the Induced and Balanced Draft Systems is not considered. It will require somewhat less steam to operate the Balanced Draft engines, but the exact saving has not been determined.

COST OF OPERATION, YEAR ENDING MARCH 20, 1907.

Interest at 5% on Balanced Draft System as installed, costing $26,000.00		$1,300.00
SUPPLIES		
69 gallons of engine oil @ 25c	$17.25	
274 gallons cylinder oil @ 50c	137.00	
		$154.25
REPAIRS		
Labor on repairs	$30.00	
Damper regulator and fulcrum keys	13.44	
Valve parts	10.00	
Cylinder for regulating valve, rings, springs and diaphragms	4.10	
Damper regulator parts	9.00	
		66.54
Labor on cleaning boilers caused by deposit back of bridge walls requiring cleaning more often than with the Induced Draft		270.00
Total cost of operation in excess of the Induced Draft System		$1,790.79
SAVING DUE TO BALANCED DRAFT		
Twenty per cent. saving in coal		$12,664.00
Cost of operation in excess of the Induced Draft		1,790.79
Net saving in the year's operation		$10,873.21

There is a further saving due to the fact that we are now carrying our load with six boilers, while formerly, with the Induced Draft System, we were compelled to operate ten boilers. This has reduced our coal consumption per kilowatt hour, as we save the coal which was formerly burned to maintain the banked fires in four of the boilers.

Yours truly,

(Signed) C. E. PARSONS,

Chief Engineer.

THE INCREASE IN ECONOMY AND CAPACITY EFFECTED BY THE INSTALLATION OF BALANCED DRAFT IN REPRESENTATIVE STEAM PLANTS

NAME OF FIRM	KIND OF DRAFT	DATE OF TEST	HOURS DURATION	TYPE OF BOILERS	RATED H. P.	H. P. DEVELOPED	INCREASED CAPACITY WITH BALANCED DRAFT	KIND OF COAL USED	COST OF COAL PER TON	POUNDS COAL CONSUMED	WATER EVAPORATED FROM AND AT 212° F.	WATER EVAPORATED PER LB. DRY COAL	WATER EVAPORATED PER LB. COMBUSTIBLE	COST OF 1000 H. P. PER HOUR	SAVING EFFECTED
							Per cent		Dollars	Pounds	Pounds	Pounds	Pounds	Dollars	Per cent
Standard Oil Co., Bayonne, N. J.	Forced	2 tests	‡8	W. T.	250	275		Rice		10,433	76,092	7.29	9.35		
	Balanced	2 tests	‡7‡	W. T.	250	302	10.0	Rice		8,797	75,798	8.59	10.38		15.2
American Smltg. and Rf. Co., Perth Amboy, N. J.	Forced	Dec. 13, '04	20	W. T.	500	505		Rice	1.75	47,282	348,145	7.35	9.22	4.10	
	Balanced	May 26, '05	10	W. T.	500	769	52.3	Rice	1.75	23,207	214,134	9.20	10.63	3.28	20.0
Baldwin Locomotive Works, Philadelphia, Pa.	Natural	3 tests	9	W. T.	600	587		Soft	2.70	21,114	182,071	8.62	9.71	4.82	
	Balanced	3 tests	9	W. T.	600	634	8.0	Buck	2.25	23,583	196,792	8.24	9.77	4.21	12.6
	Balanced	3 tests	9	W. T.	600	643	9.5	Rice	1.75	21,978	200,294	9.10	10.67	2.97	38.4
	Balanced	1 test	9	W. T.	600	799	36.1	Buck	2.25	28,177	247,946	8.80	10.29	3.94	18.3
Albany Water Works, Albany, N. Y.	Steam Jet	Nov. 14, '05	8	H. R. T.	340	356		Rice	2.07	14,721	107,055	7.27	8.03	5.26	
	Balanced	Dec. 5, '05	8	H. R. T.	340	420	18.0	Rice	2.07	12,479	118,250	9.46	11.57	3.79	28.0
	Balanced	Dec. 6, '05	6	H. R. T.	340	481	35.0	Rice	2.07	9,979	102,008	10.22	11.71	3.52	33.0
Hudson R. El. Power Co., Utica, N. Y.	Induced	Jan. 5, '06	10	W. T.	488	371		Mix*	2.56	14,220	107,204	9.01	9.91	4.37	
	Balanced	Jan. 13, '06	10	W. T.	488	617	66.3	Mix†	2.13	22,232	212,715	9.57	11.20	3.43	21.5
Pratt & Whitney, Hartford, Conn.	Natural	Sep. 18, '06	9½	W. T.	300	270		Soft	3.80	9,556	88,523	9.26	9.81	6.51	
	Balanced	Sep. 19, '06	9	W. T.	300	345	27.0	Soft	3.80	10,214	107,269	10.50	11.13	5.81	10.7
	Balanced	Sep. 20, '06	9½	W. T.	300	273		No. 3B	2.30	9,148	89,489	9.78	11.13	3.84	41.0

American Locomotive Co. Paterson, N. J.	Natural	5 tests	§60	W. T.	300	275		Soft	2.98	63,885	569,922	8.93		5.15	
	Balanced	5 tests	§57	W. T.	300	308	12.0	Rice	2.00	70,040	606,202	8.65		3.56	30.8
	Balanced	Sep. 26, '06	10	W. T.	300	369	34.0	Rice	2.00	14,417	127,275	8.83		3.48	32.4
	Balanced	Sep. 28, '06	10	W. T.	300	302	9.7	Barley	1.65	12,082	104,217	8.62		2.94	42.8
Roessler & Hasslacher Chemical Co., Perth Amboy, N. J. (Three installations.)	Natural	Dec. 18, '05	6	W. T.	120	124		Pea	2.80	3,750	25,623	6.83	8.15	7.10	
	Balanced	Jan. 10, '06	6	W. T.	120	185	49.0	Buck	2.20	3,956	38,294	9.57	11.80	3.96	44.0
Broad Exchange Bldg., New York.	Natural	2 tests	8	W. T.	350	317		Buck	3.50	20,250	153,134	7.50	9.00	7.19	
	Balanced	2 tests	8	W. T.	350	310		Rice	2.50	21,250	148,818	7.00	8.34	5.50	23.5
Niles, Bement, Pond Co. Works, Phila., Pa.	Natural	Oct. 16, '05	8	W. T.	135	132		Soft	2.70	4,104	31,809	7.75	8.83	5.37	
	Balanced	Oct. 17, '05	8	W. T.	135	195	47.7	Rice	1.75	6,032	47,260	7.83	9.16	3.45	35.0
Land Title and Trust Bldg., Philadelphia, Pa.	Natural	Sep. 14, '05	10	W. T.	231	226		Buck	2.90	9,216	78,022	8.46	10.80	5.65	
	Balanced	Sep. 10. '05	10	W. T.	231	259	14.6	Rice	2.32	9,827	89,304	9.09	10.99	4.11	25.75
Strawbridge & Clothier, Philadelphia, Pa.	Natural	July 25, '05	8	W. T.	190	209.4		Buck	3.25	6,092	57,799	9.49	11.23	5.27	
	Balanced	Aug. 2, '05	8	W. T.	190	227.4	8.59	Rice	2.25	6,881	62,759	9.09	10.96	3.81	27.2
Davies & Thomas Co., Catasauqua, Pa.	Forced	Jan. 31, '07	11	W. T.	600	468.9		No. 3B	1.35	27,670	177,961	5.29	8.02	3.35	
	Balanced	Feb. 19, '07	11	W. T.	600	460		No. 3B	1.35	19,770	174,699	7.27	11.07	2.44	27.2
Flatiron Building, New York.	Natural	Sep. 20, '04	12	W. T.	340	267		Soft	4.00	10,440	102,065	9.77	10.60	6.40	
	Balanced	May 2, '05	10	W. T.	340	383	43.4	Rice	2.68	12,520	120,400	9.61	11.25	4.20	34.3
	Balanced	May 9, '05	10	W. T.	300	388	43.8	Soft	4.00	11,606	133,622	11.50	12.10	5.33	16.7
Mutual Life Ins. Bldg., New York.	Natural	Aug. 14, '05	9	W. T.	300	139		Brkn	4.95	4,643	43,080	9.28	11.21	8.20	
	Balanced	Aug. 16, '05	9	W. T.	150	167	20.1	Buck	3.25	5,130	51,820	10.10	11.95	4.95	39.6
Fidelity Mutual Life Bldg., Philadelphia, Pa.	Natural	Mar. 12, '05	9	W. T.	200	183		Buck	3.75	7,366	63,150	8.56	10.82	7.05	
	Balanced	Mar. 11, '05	9	W. T.	200	217	18.6	Rice	2.75	7,776	75,000	9.63	12.35	4.60	33.8

* A mixture of 30 per cent screenings and 70 per cent soft coal † A mixture of 84 per cent screenings and 16 per cent slack ‡ Hours each § Total time of 5 tests

U. S. Treasury Department Buildings, Washington, D. C., where a system of down-draft was supplanted by The Balanced Draft System of Furnace Regulation.

The following list of installations represents upwards of one-half million horse-power under which The Balanced Draft System has been applied, with a resultant actual net average saving of thirty per cent. (30%) over original cost of operation.

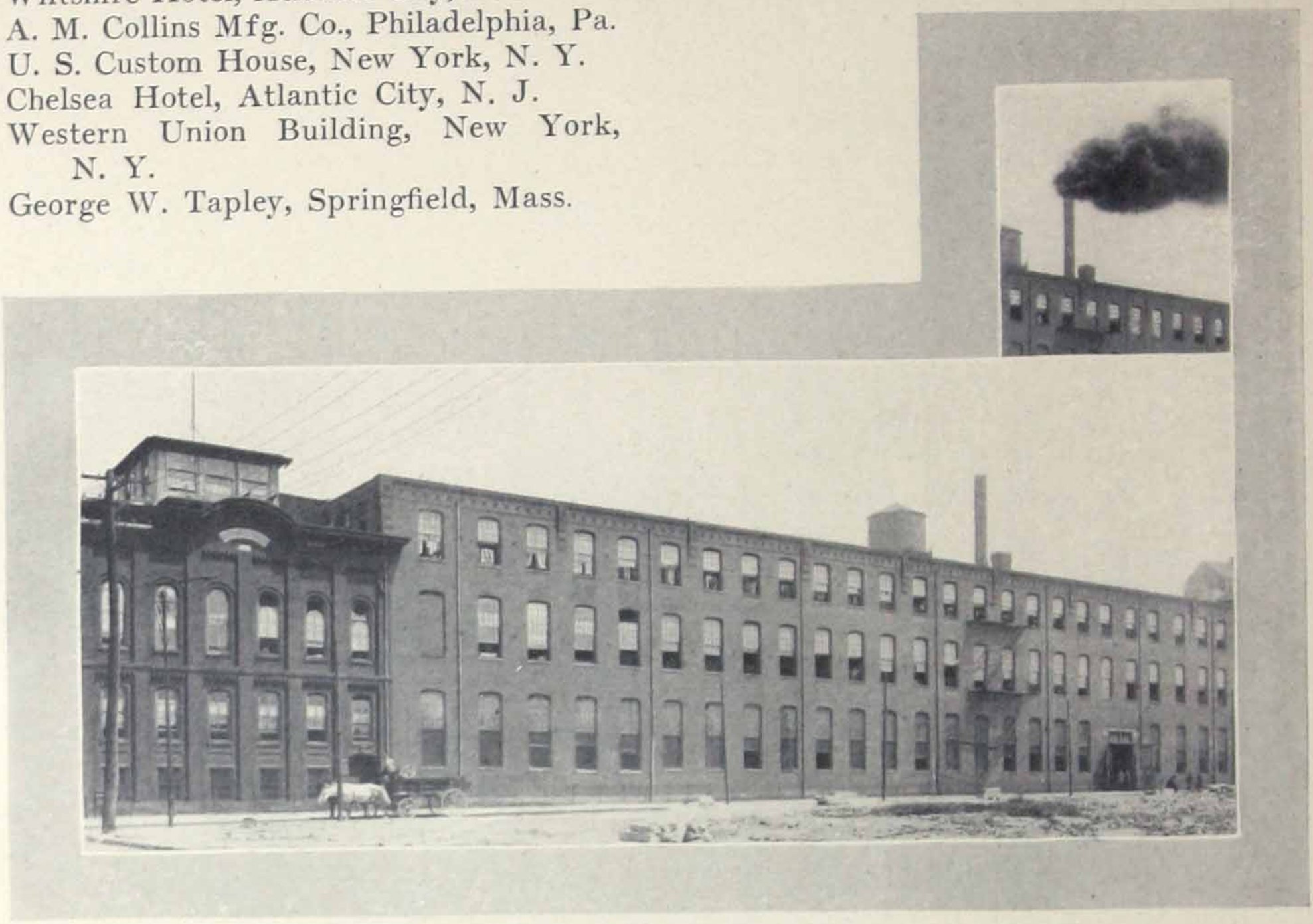
U. S. Treasury Building, Washington, D. C.
State, War & Navy Dept. Bldg., Washington, D. C.
Seven Wall Street, New York, N. Y.
Milliken Bros., Inc., Mariner's Harbor, S. I.
Manhattan Life Ins. Bldg., New York, N. Y.
American LaFrance Fire Eng. Co., Elmira, N. Y.
Charles Parker Co., Meriden, Conn.
Harrisburg Lt. Ht. & Pr. Co., Harrisburg, Pa.
S. O. & C. Company, Ansonia, Conn.
Johnson & Johnson, New Brunswick, N. J.
Liquid Carbonic Company, New York, N. Y.
Metropolitan Museum of Art, New York, N. Y.
United Lead Co., Perth Amboy, N. J.
Rochester Ry. & Light Co., Rochester, N. Y.
Clark Bros. Bolt & Nut Co., Milldale, Conn.
Wm. H. Grundy & Co., Bristol, Pa.
Roland Park Elec. & Water Co., Roland Park, Md.
Bayless Pulp & Paper Co., Austin, Pa.
Union Typewriter Company, Bridgeport, Conn.
Davies & Thomas Co., Catasauqua, Pa.
Albany Water Works, Albany, N. Y.
Roessler & Hasslacher Chemical Co., Perth Amboy, N. J. (three plants).
Susquehanna Silk Mills, Sunbury, Pa.
American Locomotive Co., Paterson, N. J.
Schofield-Mason & Co., Philadelphia, Pa.
Perth Amboy Water Works, Runyon, N. J.
Williamson Bros. Co., Philadelphia, Pa.
A. B. Kirschbaum & Co., Philadelphia, Pa.
Wm. Kleeman & Company, New York, N. Y.
Pierrepont Hotel, New York, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Textile Machine Works, Wyomissing, Pa.
Wm. Wilkins Company, Baltimore, Md.
C. A. Dorney Furniture Company, Allentown, Pa.
Yacht "Yacona" (H. Clay Pierce), New York, N. Y.
Vulcanite Portland Cement Co., Vulcanite, N. J. (two plants).
Hudson River Elec. Power Co., Utica, N. Y.
Crystal Run Coal Company, Frackville, Pa.
Babcock & Wilcox Co., New York, N. Y.
Perth Amboy Chemical Co., Perth Amboy, N. J.
Exchange Court Bldg., 52 Broadway, New York, N. Y.
Frank Schoble & Company, Philadelphia, Pa.
Bergdoll Brewing Company, Philadelphia, Pa.
John B. Stetson Company, Philadelphia, Pa.
Chambers Bros. Co., Philadelphia, Pa.
John Hancock Building, Boston, Mass.
Land Title & Trust Co., Philadelphia, Pa.
American Tube & Stamping Co., Bridgeport, Conn.
Brooklyn Post Office, Brooklyn, N. Y.
Strawbridge & Clothier, Philadelphia, Pa.
American Smelting & Refining Co., Perth Amboy, N. J.
Brooklyn Bridge Frz. & Cold Stge., New York, N. Y.

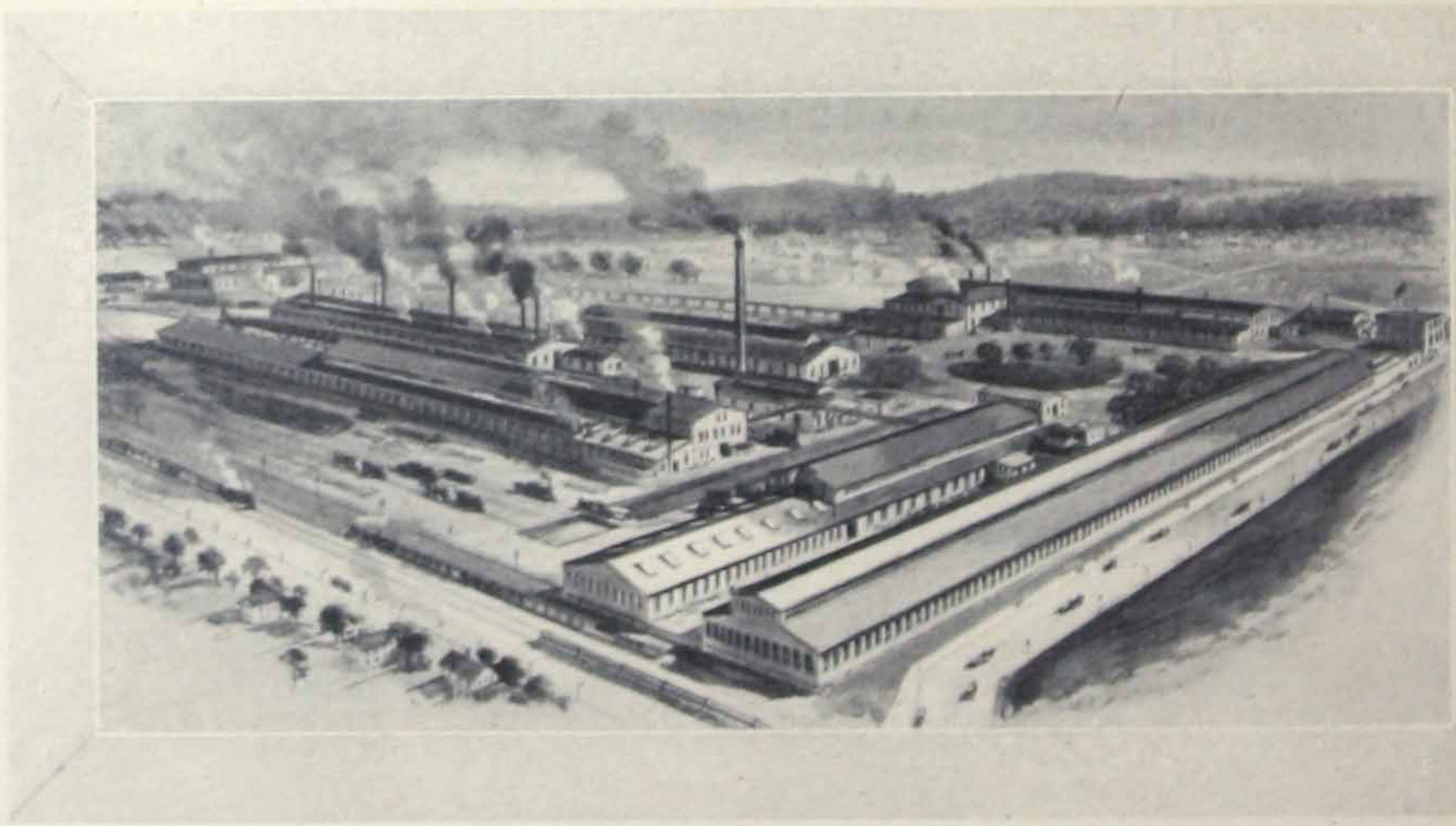
Metropolitan Museum of Art, New York. Power and lighting plant equipped with The Balanced Draft System of Furnace Regulation.

A. C. Yates Company, Philadelphia, Pa.
City & Suburban Homes Company, New York, N. Y.
E. R. Squibb & Son, Brooklyn, N. Y.
Philadelphia Freezing Company, Philadelphia, Pa.
Bement-Miles & Company, Philadelphia, Pa.
Ivins, Deitz & Metzger Co., Philadelphia, Pa.
Dill & Collins Company, Philadelphia, Pa.
Midvale Steel Company, Philadelphia, Pa.
Lehigh Mfg. Company, Philadelphia, Pa.
Isaac H. Blanchard Co., New York, N. Y.
Baldwin Locomotive Works, Philadelphia, Pa.
North American Building, Philadelphia, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.
St. Catherine's Hospital, Brooklyn, N. Y.
Old Mutual Life Bldg., 145 B'way, New York, N. Y.
American Surety Building, New York, N. Y.
Fuller Building, New York, N. Y.
John Simmons Company, New York, N. Y.
B. T. Babbitt, New York, N. Y.
Morgan Steam Power Company, Springfield, Mass.
Foster Engineering Co., Newark, N. J.
Kibbe Bros., Springfield, Mass.
Broad Exchange Building, New York, N. Y.
Jacques Kahn, New York, N. Y.
S. M. Milliken, 79 Leonard St., New York, N. Y.
Fidelity Mutual Building, Philadelphia, Pa.
West Chester Ry. Co., West Chester, Pa.

Wm. Sellers Company, Philadelphia, Pa.
Barney & Berry, Springfield, Mass.
Traymore Hotel, Atlantic City, N. J.
Wiltshire Hotel, Atlantic City, N. J.
A. M. Collins Mfg. Co., Philadelphia, Pa.
U. S. Custom House, New York, N. Y.
Chelsea Hotel, Atlantic City, N. J.
Western Union Building, New York, N. Y.
George W. Tapley, Springfield, Mass.
Chas. T. Bainbridge's Sons, Brooklyn, N. Y.
J. F. Tapley Co., New York, N. Y.



Niles, Bement-Pond Co., Philadelphia. The small picture represents the same plant prior to the installation of Balanced Draft (see Table of Tests, showing savings effected on pages 16 and 17).



Cooke Works, American Locomotive Co., Paterson, N. J. Balanced Draft has been successfully installed in their power house (see Table of Tests, pages 16 and 17).

United Lead Company,
Perth Amboy, N. J.

August 27, 1907.

The Engineer Company,
111 Broadway,
New York City.

Gentlemen: Referring to yours of August 15th, asking for information as to our experience with your "Balanced Draft" System.

We have had the "Balanced Draft" System in operation since January 29th, 1907, and consider it an economical artificial draft installation. We believe that through its use a more uniform condition is maintained in the fire boxes of our boilers than could be maintained by the usual hand firing and damper regulation. We are enabled to use low grade anthracite coals, and reduce our fuel bills below their cost, using soft coal and natural draft.

Yours very truly,
Richard Bigelow,
Manager White Lead Dept.

Bristol, Pa., July 3, 1907.

C. J. Milne & Sons,
11th & Washington Ave.,
Philadelphia, Pa.

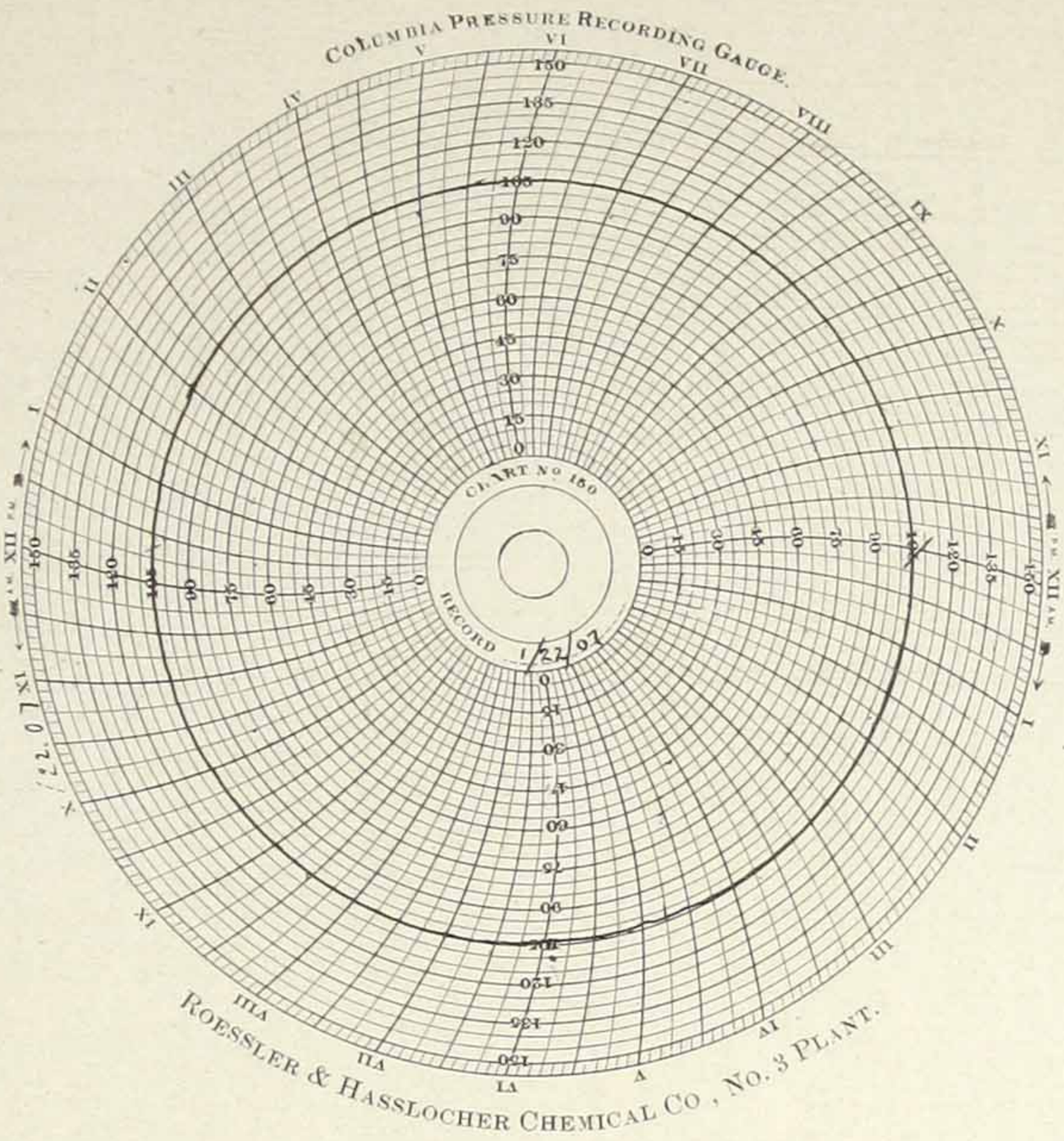
Gentlemen: Since writing you a short time ago in regard to the Balanced Draft System constructed by The Engineer Co., we have made several tests and the results are very satisfactory to us.

Our Pressure Gauge charts show very steady steam. The result of coal used is very little more if any than the tests made by Mr. Jay M. Whitham, and the ash has been from 16½% to 21%.

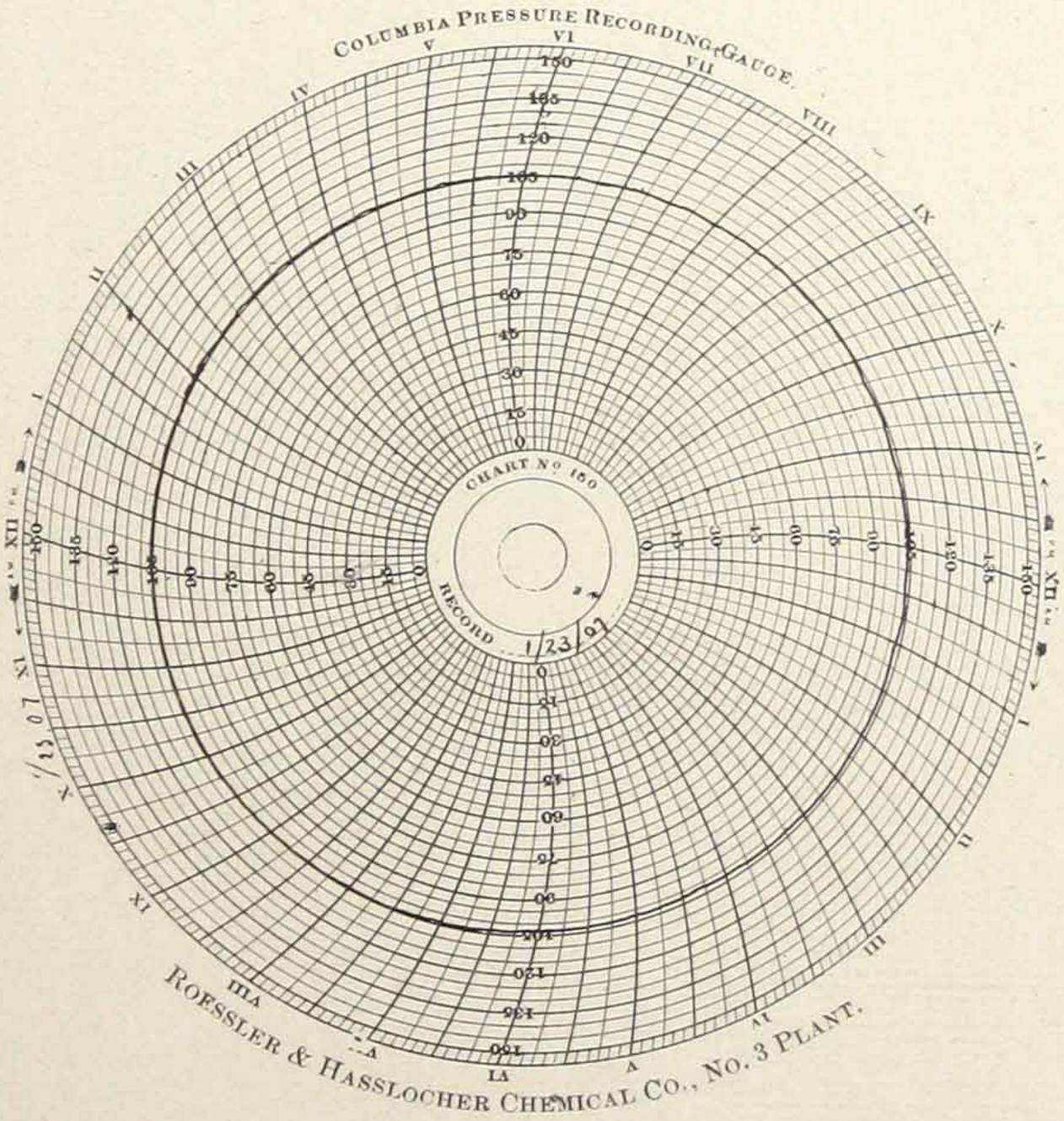
We shall be pleased to have you visit our plant at any time, but would suggest not next week, as we are repairing our large boilers, and of course will be rather upset, but after that we shall be glad to see you.

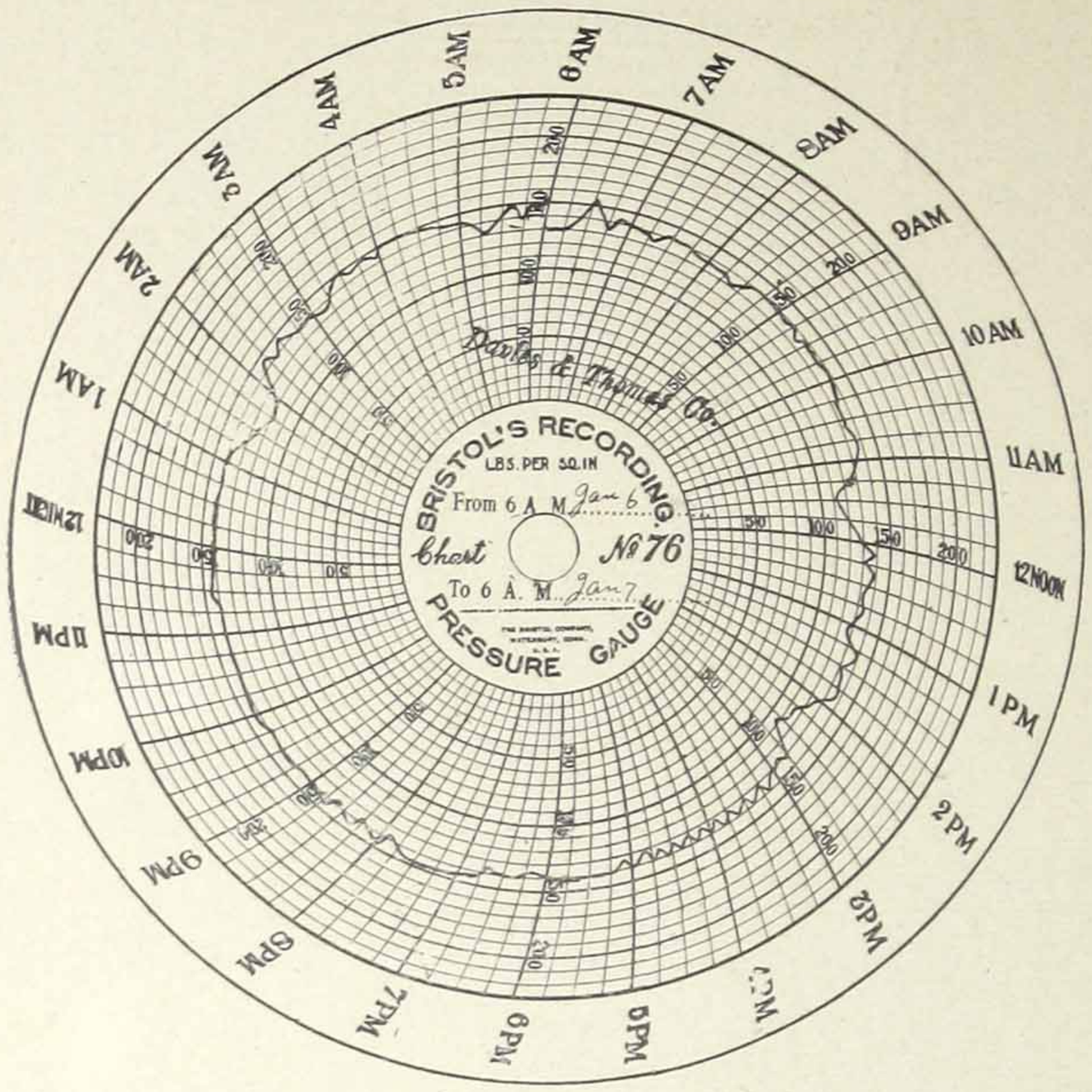
There is one thing I would call your attention to, and that is the system is much easier on the brick work of the furnaces, in fact I think the repairs will not be over one-third of what they were when using soft coal.

Yours very truly,
(Signed) Wm. H. Grundy & Co.,
Wm. V. Leech, *Supt.*

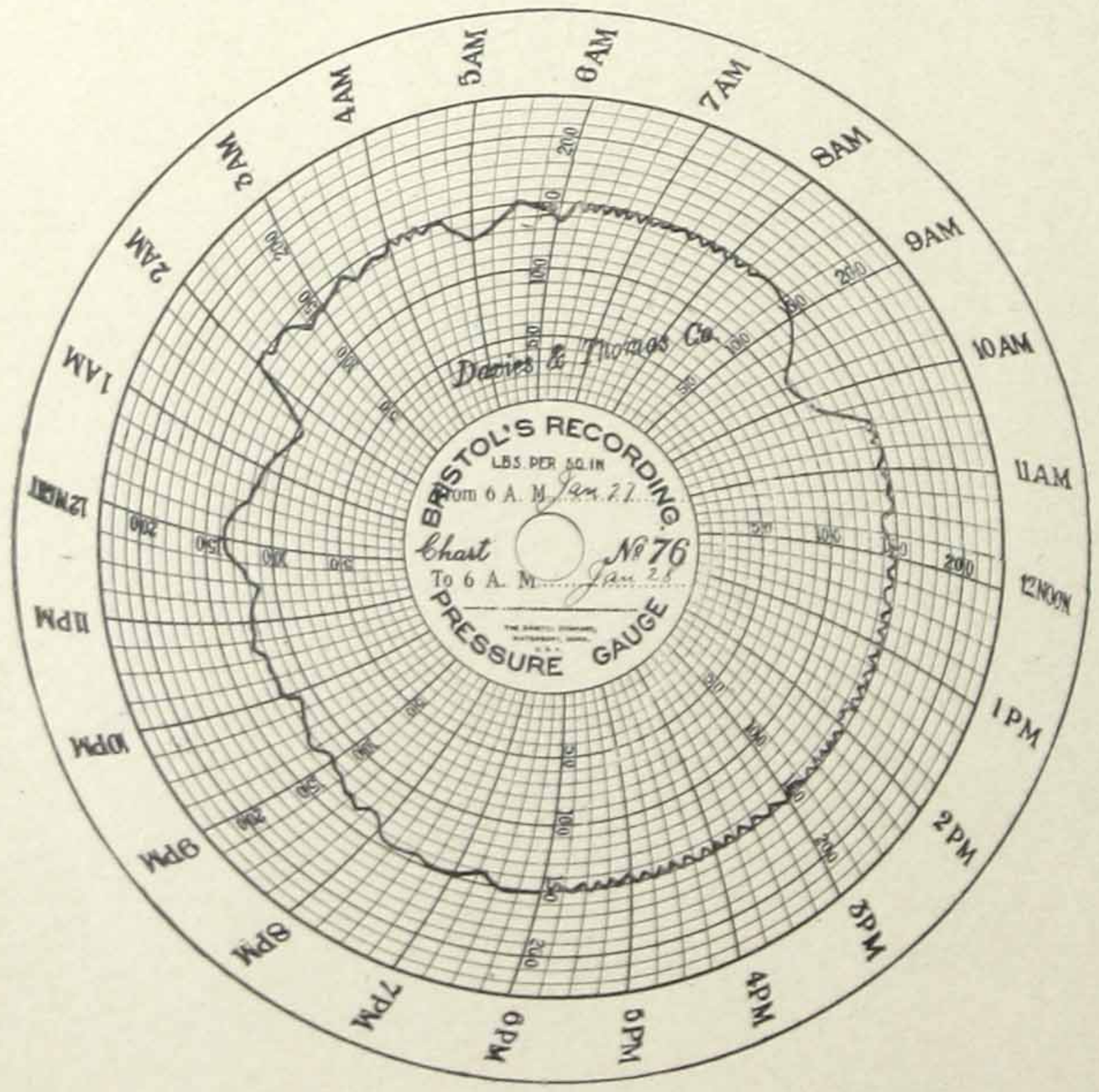


The photo-engravings shown on this page are reproductions of ACTUAL steam-pressure charts made at No. 3 Perth Amboy plant of Roessler & Hasslocher Chemical Co., January 22 and 23 respectively, 1907.





The illustrations herewith shown are photo-line reproductions of ACTUAL pressure gauge charts made January 6-7, and January 27-28, 1907, at the Catasauqua, Pa., plant of Davies & Thomas Co., using forced draft with automatic regulation, PRIOR to the installation of Balanced Draft.



A. B. KIRSCHBAUM COMPANY,
PHILADELPHIA, Aug. 21, 1907.
The Engineer Company,
111 Broadway, N. Y.

Gentlemen: Yours received in reference to your "Balanced Draft" System, installed in our plant some twelve months ago; in reply beg to state, that your system is all right, and we would not be without it. As you know we have three (3) 100 H.P. return tubular boilers; previous to putting in "Balanced Draft," we used a good grade of George's Creek bituminous coal, and in the winter months we used all three of our boilers, in the summer months we used two. With "Balanced Draft," burning rice coal, last winter we used two boilers, and in the summer months we could get along with one if it were not for the sudden change in our electrical load; the saving with "Balanced Draft" as shown by the test was 22%, this I think we can maintain in the winter months, but in the summer months with two boilers, and most of the time not enough work for them to do, the efficiency would naturally drop to some extent. Our recording gauge shows perfect steam line at all times with your system. In regard to overload, we have no trouble in obtaining an increase of 85% with rice coal.

Yours very truly,
ALBERT J. TRICKER,
Chief Engineer.

AUSTIN, POTTER COUNTY, PA.,
August 29, 1907.
THE ENGINEER CO., Trinity Bldg., New York City.

Gentlemen: Replying to your recent favor relative to your "Balance Draft System," which we have had in operation since last November attached to our 3000 rated H. P. boilers; would say, that at the time the installation was made we were burning soft coal slack with natural draft, and are still using the same quality of fuel. The "Balance Draft System" makes us a saving of 10 to 12½%.

Very truly yours,
Bayless Pulp & Paper Co.,
GEO. C. BAYLESS, *Pres.*

BALTIMORE, October 4, 1906.

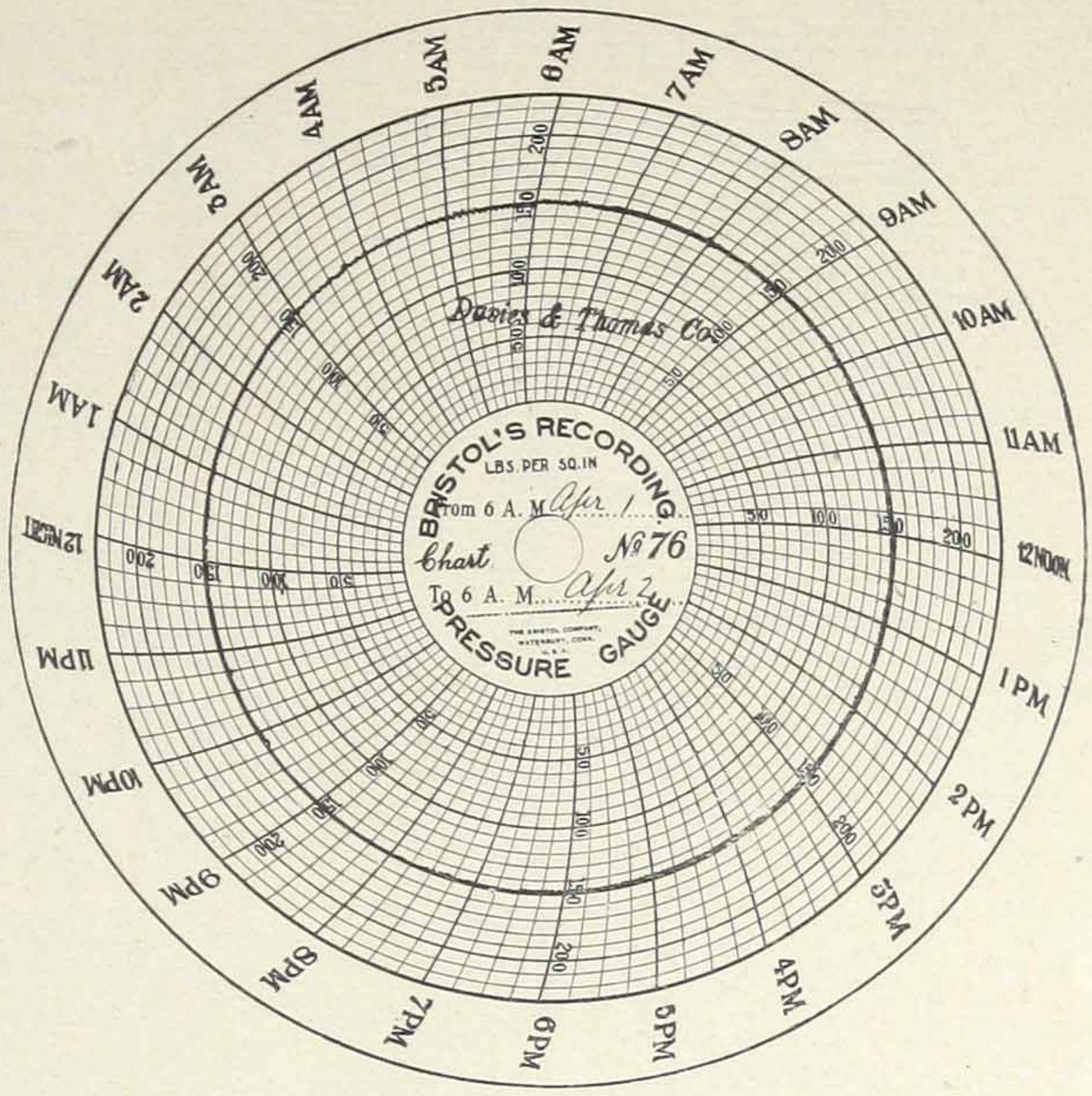
THE ENGINEER COMPANY,
Equitable Building,
Baltimore, Md.

Gentlemen: Replying to your favor under date of the 1st inst., inquiring as to the commercial saving and increased boiler capacity, effected by your system of "Balanced Draft," we are pleased to reply as follows:

In 1905 *with natural draft,* we had difficulty in carrying our steam load with seven (7) boilers, and ten (10) tons of coal per day, at $2.90 per ton, or $29.00 per day.

In 1906 *with "Balanced Draft,"* we are easily carrying an increased load (due to the expansion of our business) with five (5) boilers, seven (7) tons of coal per day, at $2.10 per ton, or $14.70 per day, without any smoke.

Very respectfully,
The William Wilkens Co.,
FRED'K W. SCHLENS, *Sec'y.*



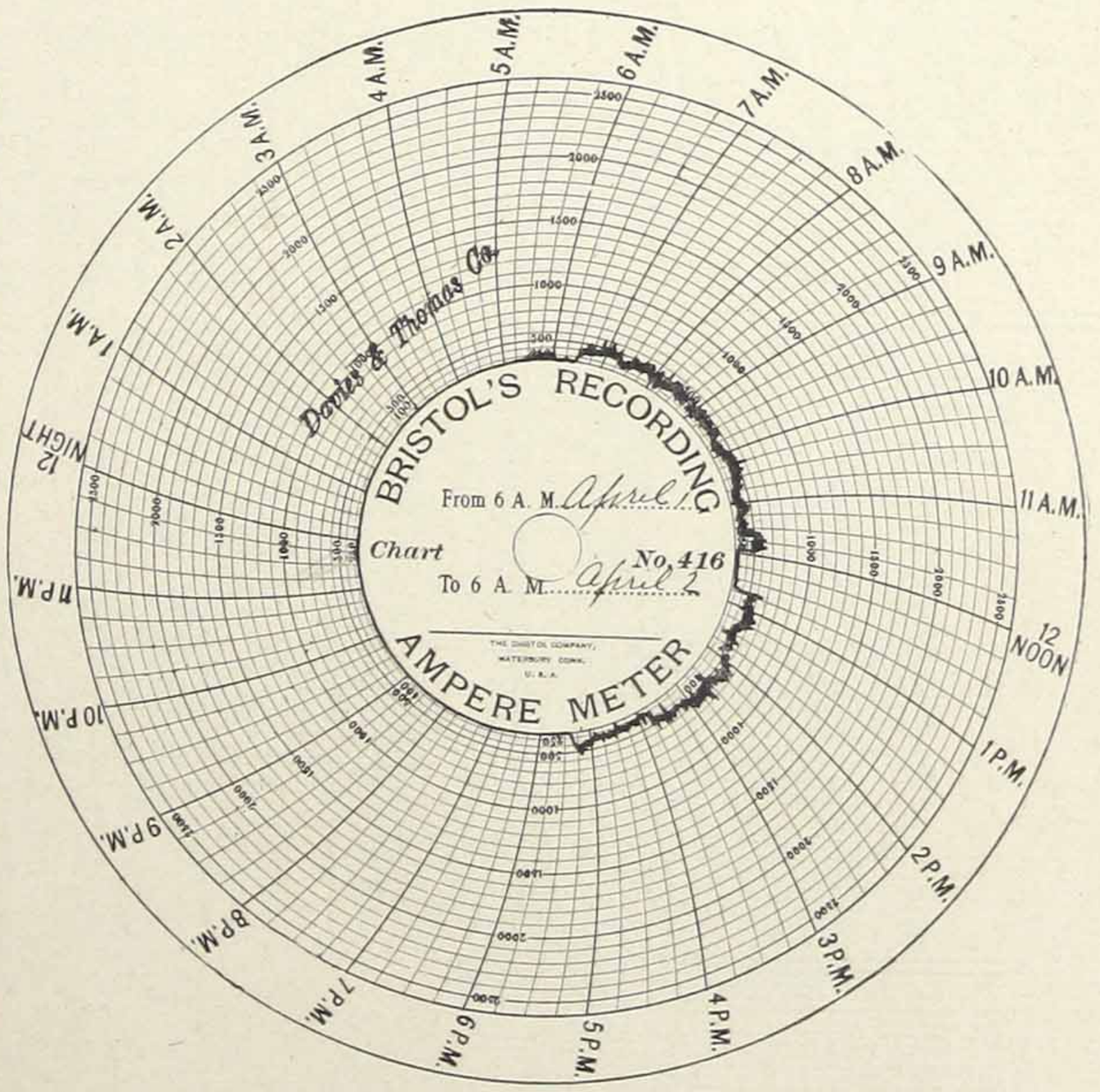
The upper illustration is a photo-engraving from an actual steam-pressure chart made at Davies & Thomas Co.'s Catasauqua, Pa. plant, April 1-2, 1907, AFTER the application of The Balanced Draft System. The lower cut shows the ammeter chart made simultaneously with the upper one. Note, that when the load was thrown off at noon and on again at 12:45 P.M., the steam-pressure gauge showed no deviation.

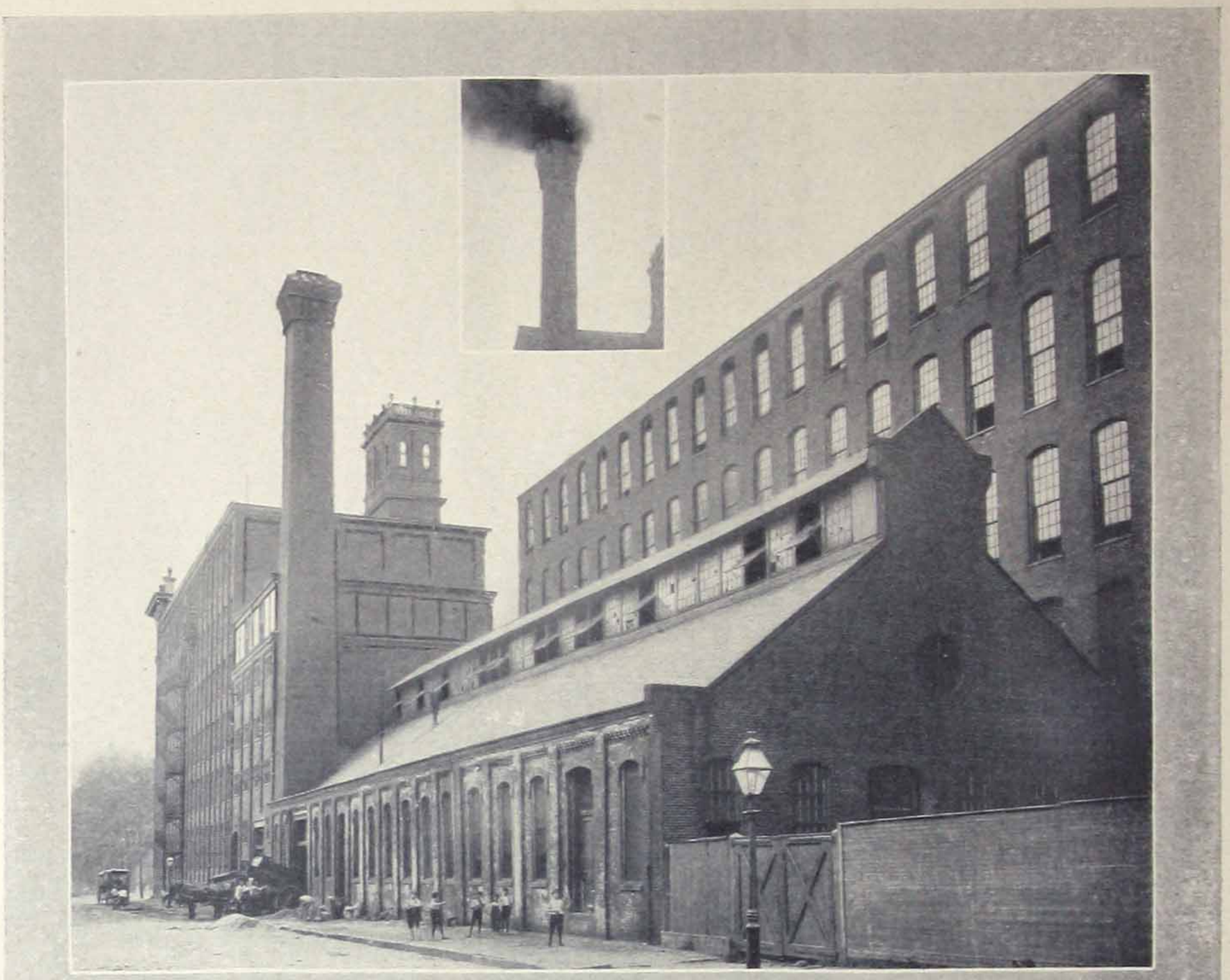
PHILADELPHIA, Aug. 20, 1907.

THE ENGINEER COMPANY,
Philadelphia, Pa.

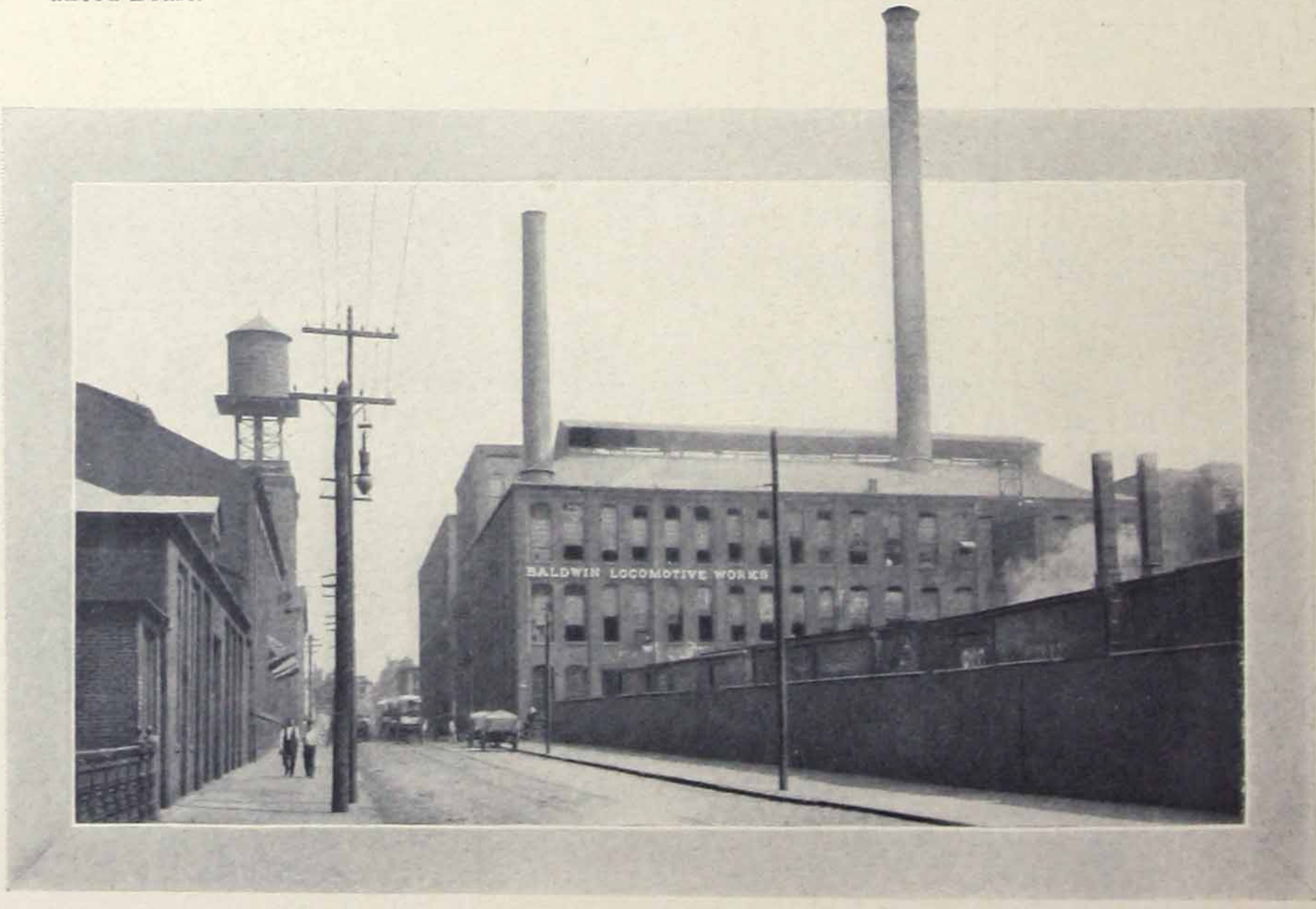
Gentlemen: You will recall our installing your Balanced Draft System just about a year ago. We were at that time using the Hawley down draft on our five boilers, which had a capacity of 1175 H.P. Our reasons for making the change was primarily to get rid of the smoke from soft coal, and secondarily to increase the capacity of our boilers. At the test made after the installation of your system we succeeded in obtaining a 50% overload using rice coal, since which we have continued using with entire satisfaction, obtaining under ordinary working conditions an overload of about 33⅓%. We do not know what saving, if any, has been effected, as we have kept no particular record along this line. Your system, however, has given us entire satisfaction, we having no difficulty in procuring all the steam we need, and have very much less trouble with our firemen than before.

Yours very truly,
JOSEPH H. BROMLEY.





The two pictures here shown are respectively the 17th and 16th Streets plants of Baldwin Locomotive Works, Philadelphia, both of which are equipped with The Balanced Draft System of Furnace Regulation. In the upper one the small picture shows the 17th Street plant before the application of Balanced Draft.



LIVINGSTON GIFFORD.
J. EDGAR BULL.

WASHINGTON LIFE BUILDING,
141 BROADWAY.

GIFFORD & BULL,

Counsellors at Law,

NEW YORK, 30th November, 1906.

JAY M. WHITHAM, ESQ.,
Bullitt Building,
Philadelphia, Pa.

DEAR SIR:

We are requested to state whether at all, or to what extent, the Balanced Draft System of operating furnaces is patented. This system is broadly covered by two patents, Nos. 817,438 and 826,349, both granted to Embury McLean and now owned by The Engineer Company, of this city. The patent No. 817,438 broadly covers the combination of devices which are necessarily present in such a system, while patent No. 826,349 broadly covers the process involved in such a system. **A reference to the claims of these patents will show that the protection afforded by them is exceptionally complete.** The Engineer Company also owns additional patents on details of construction and operation, all of which are, however, necessarily dominated by the foundation patents above referred to.

Very truly yours,

(Signed) GIFFORD & BULL.

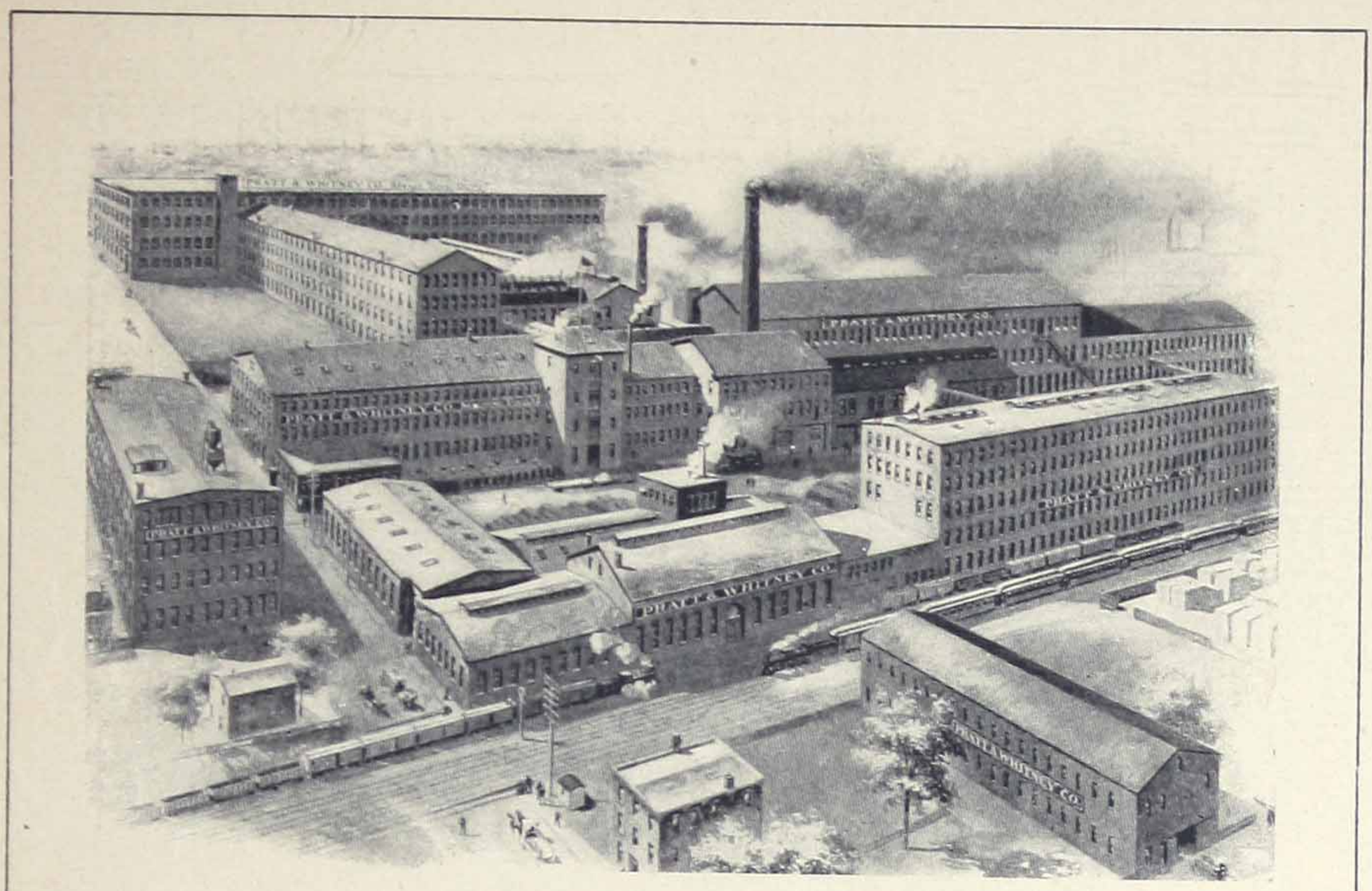
AS A MATTER OF FACT

Chimney Draft is, with one exception, the most expensive way possible. The exception is a steam jet blower.

Comparisons

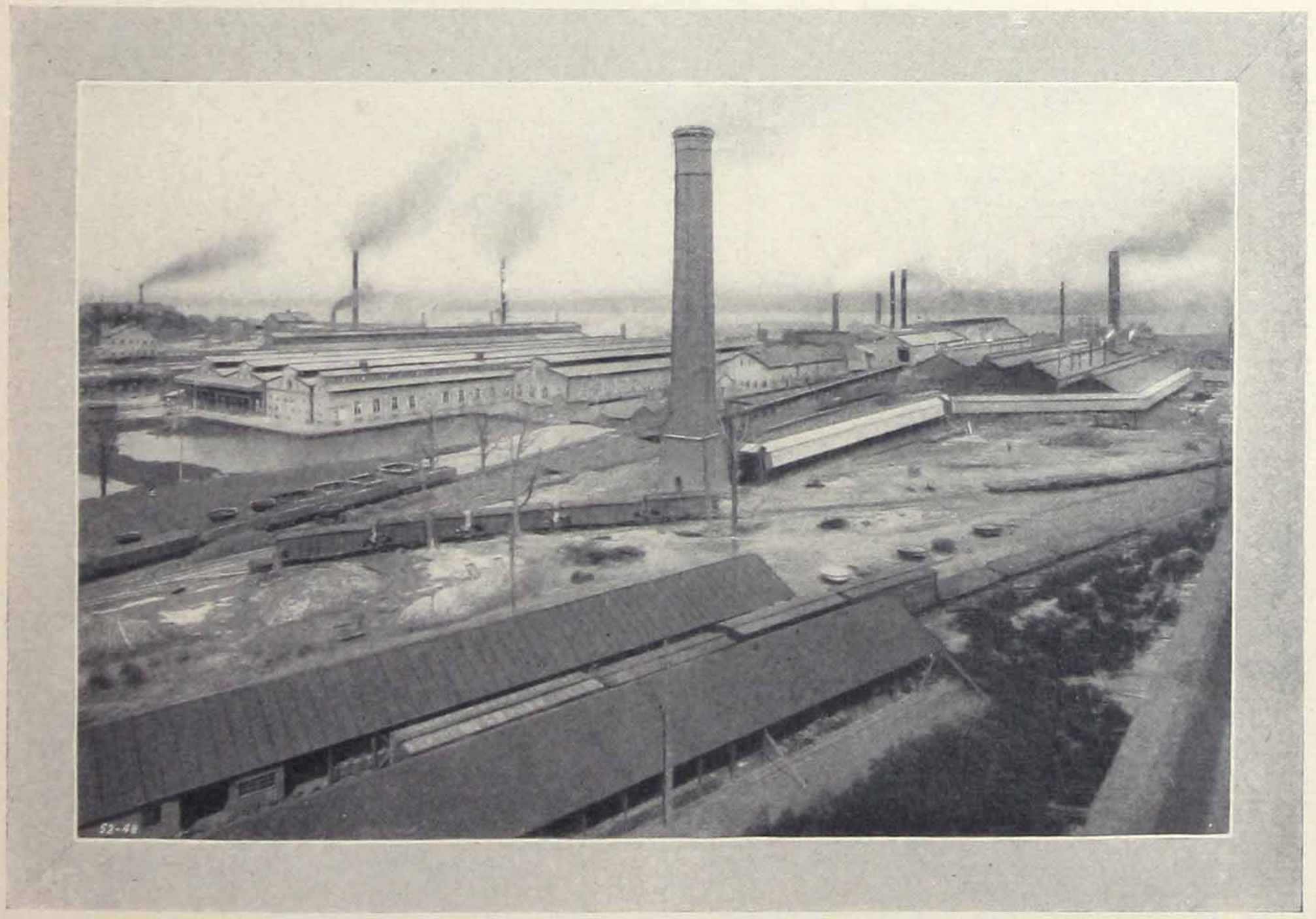
On a broad scale the advantages of "Balanced Draft" over Natural Draft for steam boilers may be summed up as follows:

WITH "BALANCED DRAFT"	WITH NATURAL OR CHIMNEY DRAFT
I. "Balanced Draft" is adaptable to any fuel.	I. The fuel must be adapted to the natural draft conditions.
II. "Balanced Draft" is at all times under constant control. It responds instantly to quick changes of boiler load without warning, and maintains a uniform steam pressure.	II. Natural Draft cannot be increased beyond the suction power of the stack; consequently it cannot take care of quick changes of load and fluctuations of the steam pressure result.
III. "Balanced Draft" operates efficiently for all conditions of fire, as the rate of combustion is independent of the thickness of bed of fuel.	III. Natural Draft varies with the thickness of bed of fuel. Consequently fires have to be kept clean and thin to enable the chimney to do its work effectively.
IV. Furnaces operated with "Balanced Draft" are ordinarily cleaned every six to twelve hours.	IV. Furnaces operated with Natural Draft require cleaning every three to six hours.
V. The condition of the furnace is maintained uniform, and is independent of atmospheric conditions.	V. Changes in external temperatures and atmospheric conditions influence chimney draft. In calm, damp or muggy weather, draft conditions are poor, resulting in imperfect combustion.
VI. The "Balanced Draft" apparatus is portable and flexible as to arrangement, and can be adapted to any existing condition of the boiler plant.	VI. Natural Draft fixtures are usually permanent and inflexible, and do not readily permit changes to meet new conditions.
VII. "Balanced Draft" apparatus can be readily extended to take care of additional boiler plant.	VII. It is difficult and expensive to increase the capacity of a chimney. A new stack is often required to take care of additions to a boiler plant.
VIII. "Balanced Draft" can effectively burn any class or quality of coal, obtaining from the same maximum heat units with a minimum velocity of travel through the boiler.	VIII. To effectively burn low-grade fuel with Natural Draft, a very high chimney is required, which necessarily means a high velocity of travel of the gases through the boiler, and a large excess of air beyond the amount that combines with the coal.
IX. "Balanced Draft" can be operated by about one-tenth of the power represented by the waste heat required for a good draft in a brick chimney.	IX. Natural Draft represents extravagant waste, which can be somewhat reduced by the use of the superheater, economizers, etc.
X. The furnace lining and brick setting of a boiler operated with "Balanced Draft" will last two or three times as long as one operated with chimney draft, forced draft or induced draft.	X. Without "Balanced Draft" the furnace lining and brick work are subjected to sudden changes in temperature due to the inrush of cold air when the fire-door is opened. The unequal expansion and contraction due to this cause produce disintegration of the brickwork.
XI. "Balanced Draft" prolongs the life of the boiler and reduces the expense for repairs.	XI. The sudden changes on temperature when "Balanced Draft" is not used produce great internal strains on the boiler and cause leaky tubes and headers.



Bird's-eye-view of Pratt & Whitney Co., Hartford, Conn., machine tool works, in the power plant of which The Balanced Draft System of Furnace Regulation has been successfully installed.

Bird's-eye-view of American Smelting and Refining Co., Perth Amboy, N. J. Works, taken from tower of United Lead Co. The Balanced Draft System of Furnace Regulation is utilized in the power plants of both of these large industries (see letter on page 21).

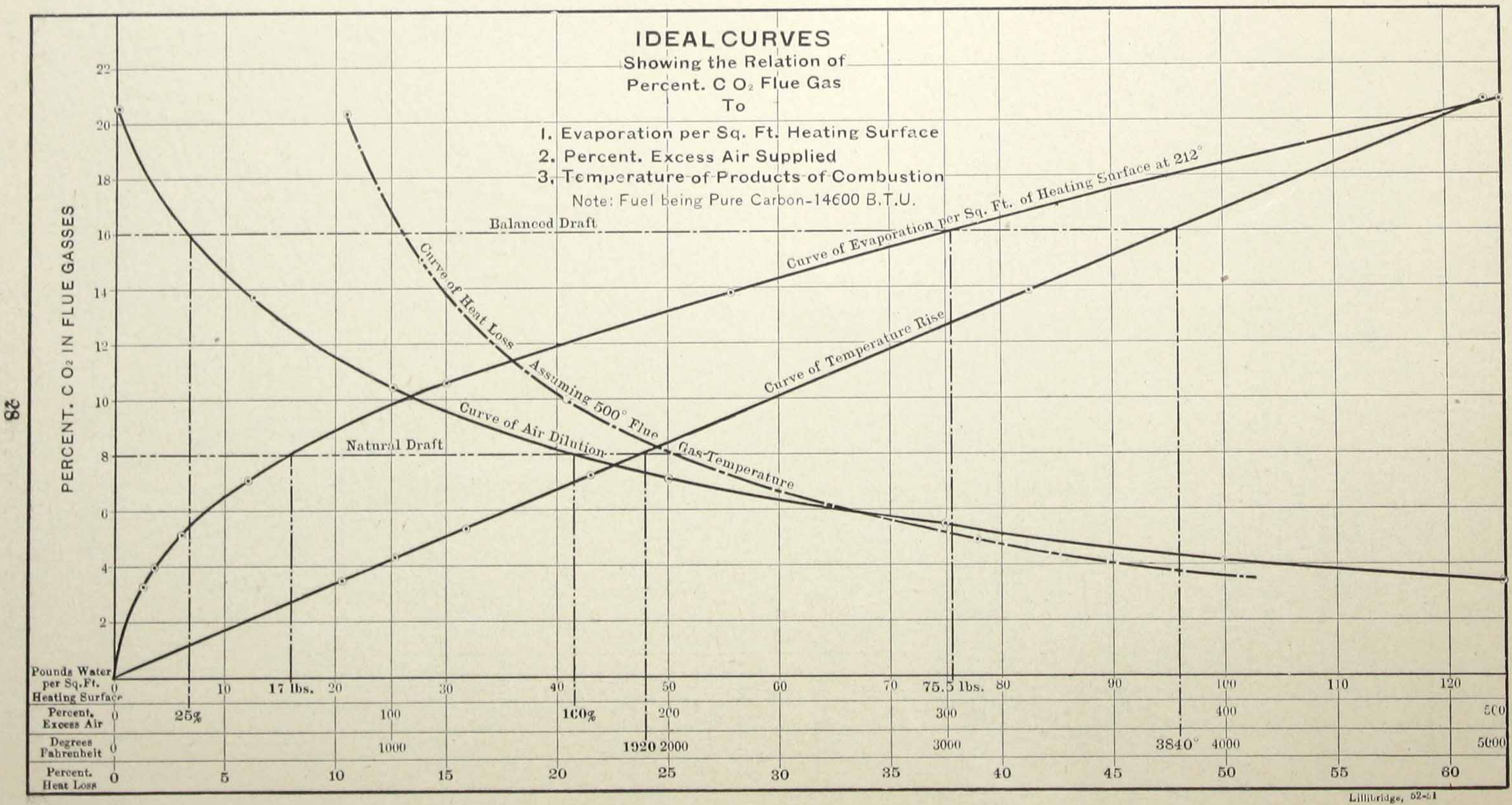


IDEAL CURVES

Showing the Relation of
Percent. CO_2 Flue Gas
To

1. Evaporation per Sq. Ft. Heating Surface
2. Percent. Excess Air Supplied
3. Temperature of Products of Combustion

Note: Fuel being Pure Carbon-14600 B.T.U.



Lillibridge, 52-61

Location.....

Date.....

THE ENGINEER COMPANY,
111 Broadway, New York.

GENTLEMEN:

The following data applies to our steam plant.

	FIRE TUBULAR BOILERS	WATER TUBE BOILERS
Number of boilers		
" " " regularly in service		
Rated H. P. each		
Maker's name		
Grates, width, depth, air space		
Hours per day boilers operated		
Hours per day fires are banked		
Maximum peak load		
Coal consumed, per day		
" " per month		
" " per annum		
Steam pressure		
Smoke stack, feet high		
" area		

We use.....(KIND OF COAL), which costs.....per ton at the plant. Is a cheaper grade of coal obtainable?.....What kind?..... Price per ton?..... We employ.....firemen and.....helpers.
We are running at an overload of.....(OMIT IF NO OVERLOAD).
The increase of horse-power capacity is a desirable consideration (?).....
The elimination of objectionable smoke is an important item (?).....

Without obligating ourselves in any way, we would be pleased to receive a proposal from you based upon your guaranteeing to appreciably increase the capacity and economy of the above plant specified amounts.

(NOTE ANY SPECIAL FEATURES, such as stokers or other special construction of furnace, economizers, etc. Give rough sketch of boiler-house and appurtenances.)

.....

.....

.....

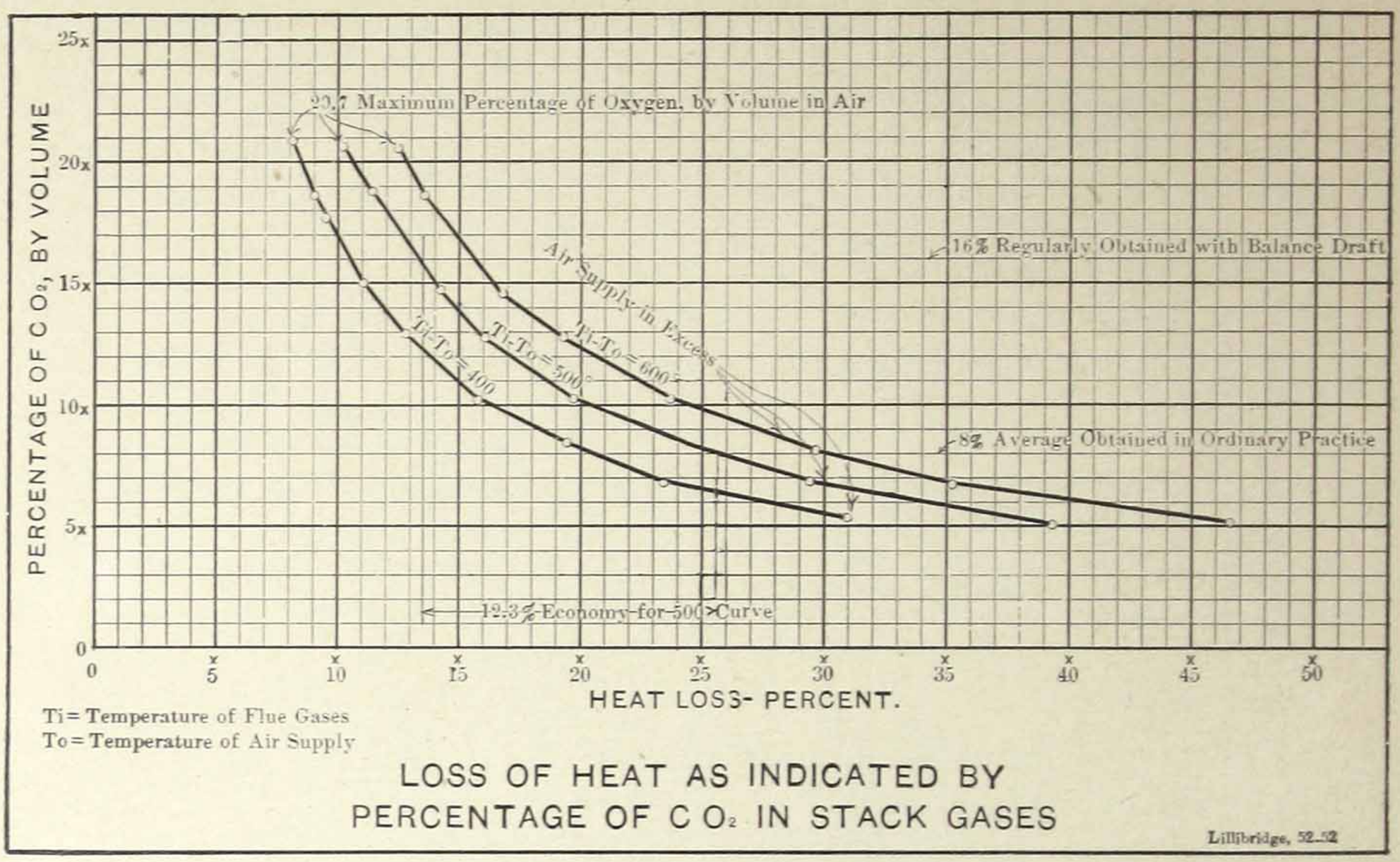
.....

.....

Yours truly,

.....

by.....



LOSS OF HEAT AS INDICATED BY
PERCENTAGE OF C O2 IN STACK GASES

Lillibridge, 52-52

THE "BALANCED DRAFT" SYSTEM

(Registered Trade Mark)

THE ENGINEER COMPANY

111 Broadway, New York.

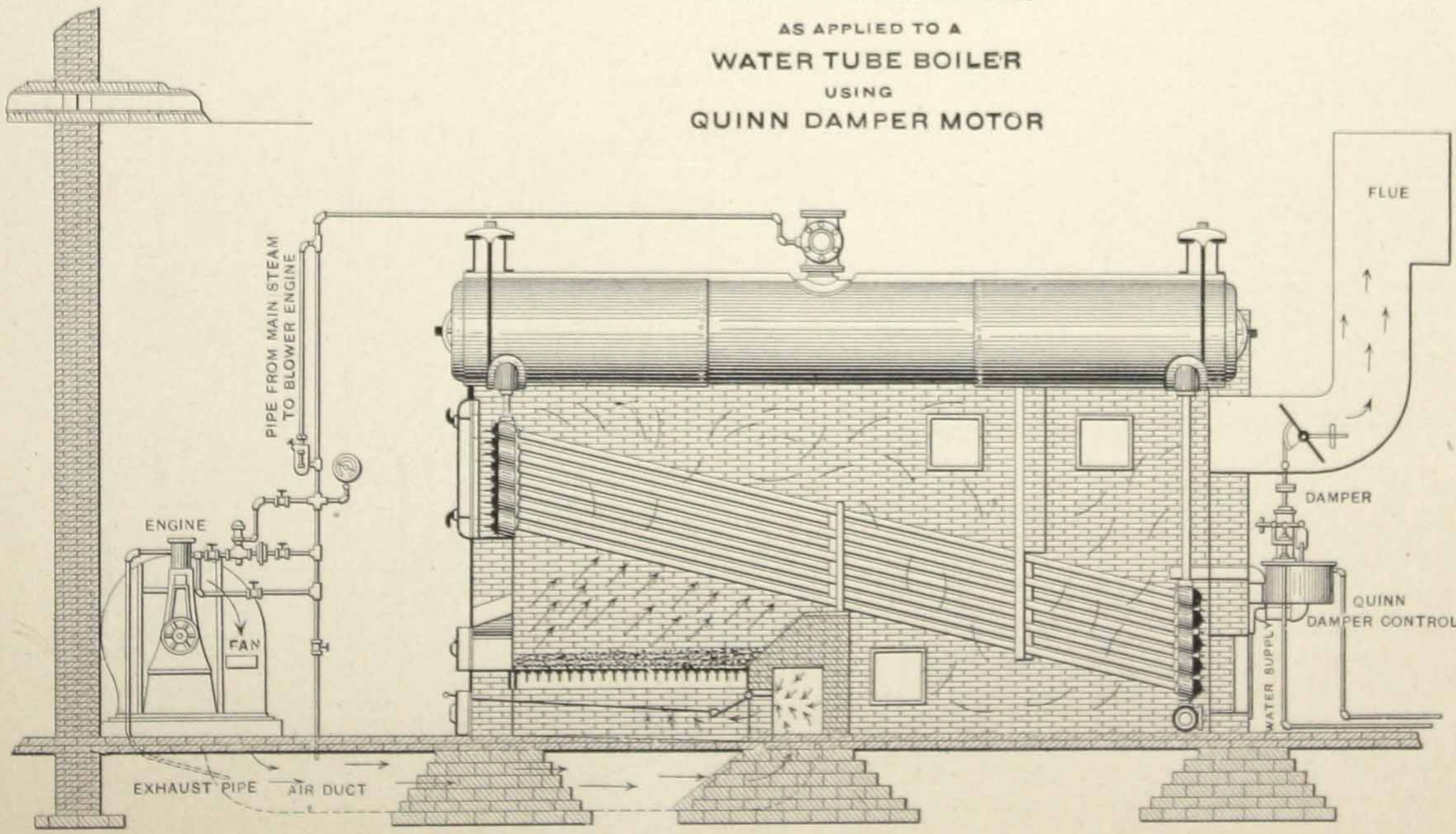
SECTIONAL ELEVATION

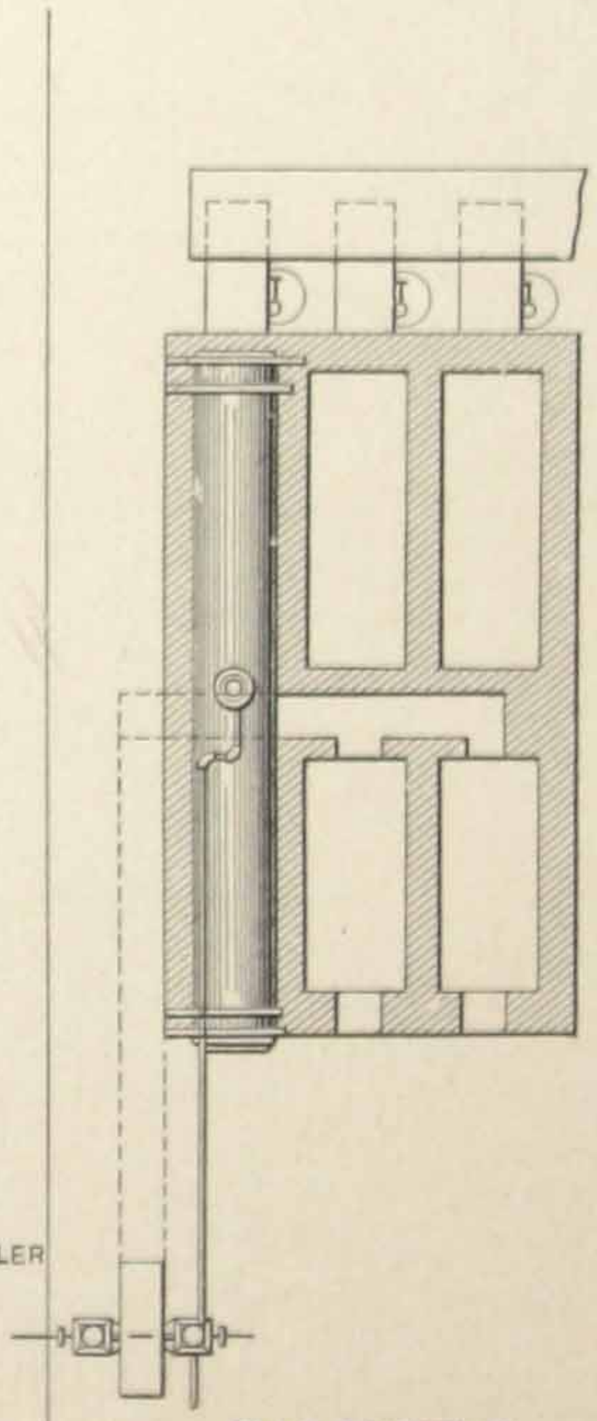
AS APPLIED TO A

WATER TUBE BOILER

USING

QUINN DAMPER MOTOR





PLAN SHOWING

AIR DUCT TO BRIDGE WALL

AND

CONNECTIONS TO BOILER

31

NOTE.—The blower equipment can be located in any available space in the boiler room.

The term "BALANCED" as applied to Draft for furnace work, originated with Embury McLean, and was applied to the System of Furnace Regulation which he invented and patented, and which was put in commercial use by The Engineer Company. The word "BALANCED" when used in connection with Draft for furnace work, is protected by registered trade mark held by The Engineer Company.

THE ENGINEER COMPANY

NEW YORK OFFICE:

TRINITY BUILDING, 111 BROADWAY

Branch Offices in the following cities:

CHICAGO, ILLINOIS
DENVER, COLORADO
BOSTON, MASSACHUSETTS
ATLANTA, GEORGIA
PHILADELPHIA, PENNSYLVANIA
PITTSBURG, PENNSYLVANIA
BALTIMORE, MARYLAND
ST. LOUIS, MISSOURI
LEBANON, PENNSYLVANIA
SEATTLE, WASHINGTON
CATASAUQUA, PENNSYLVANIA